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**Shaw et al.**

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(54) **PANEL HOIST**

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See application file for complete search history.

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**B66C 23/48** (2006.01)  
**B66C 1/02** (2006.01)

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9/181; Y10S 212/901

#### (56) **References Cited**

##### U.S. PATENT DOCUMENTS

2,312,914 A \* 3/1943 Koszeghy ..... 269/104  
2,772,797 A \* 12/1956 Schreck ..... 414/687

(Continued)

##### FOREIGN PATENT DOCUMENTS

FR 2756549 A1 2/1996  
FR 2828875 A1 \* 2/2003 ..... B65G 7/00

##### OTHER PUBLICATIONS

International Searching Authority, Form PCT/ISA/210, Patent Coop-  
eration Treaty, PCT, International Search Report regarding interna-  
tional application No. PCT/US2014031956, 4 pages, Jul. 30, 2014.

(Continued)

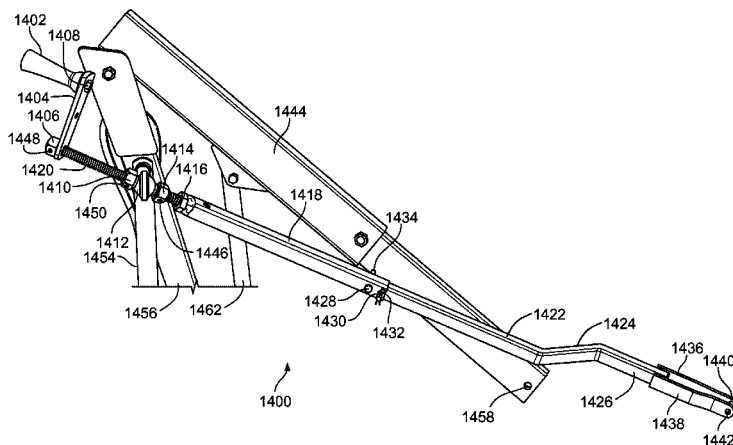
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#### (57) **ABSTRACT**

A panel hoist and components of various kits including com-  
ponents of a panel hoist are described herein. A panel hoist  
can be used to hold any of a variety of panels, such as a door  
attachable to a semi-tractor trailer, and to maneuver the panel  
for putting into a position for mounting the panel to a panel  
mounting point or for removing a panel disconnected from a  
panel mounting point. Various types of suction cups and  
supplemental panel holders can be used to hold the panel  
while the panel is moved or prepared for movement. A panel  
hoist can allow a single person to maneuver panels in various  
ways instead of having to rely on multiple people to maneuver  
the panel. Maneuvering the panel can include raising, lower-  
ing, or rotating the panel. Various panel hoist components can  
be configured as a kit.

**22 Claims, 14 Drawing Sheets**



(56)

**References Cited**

## U.S. PATENT DOCUMENTS

3,058,602	A	10/1962	Kilman	
3,349,977	A *	10/1967	Caminiti	224/314
3,734,304	A *	5/1973	Cabaniss	414/732
4,228,993	A *	10/1980	Cathers	271/236
4,600,348	A *	7/1986	Pettit	414/11
4,955,592	A	9/1990	Brennan, Sr.	
5,011,364	A *	4/1991	Anderson	414/694
5,173,002	A	12/1992	Brennan, Sr.	
5,202,132	A	4/1993	Myers et al.	
5,224,808	A *	7/1993	Macris	414/11
5,259,721	A *	11/1993	Sato et al.	414/620
5,275,390	A	1/1994	Brennan	
5,299,787	A	4/1994	Svensson	
5,516,254	A *	5/1996	Gessler	414/607
5,645,272	A	7/1997	Brennan, Sr.	
5,658,113	A	8/1997	Lazo	
5,704,755	A	1/1998	Jespersion	
5,913,561	A	6/1999	Alcorn	
6,056,499	A *	5/2000	Bressner	414/621
6,120,236	A	9/2000	Smith	
6,579,051	B2 *	6/2003	Echternacht	414/11
6,722,842	B1 *	4/2004	Sawdon et al.	414/729
7,164,391	B2 *	1/2007	Lin et al.	343/882
7,448,598	B1	11/2008	Elmlinger et al.	
7,581,915	B1	9/2009	Bristol	
7,686,310	B2	3/2010	Perkins	
7,887,109	B2 *	2/2011	Liao	294/187
7,988,161	B2 *	8/2011	Kilday	280/79.11
8,403,112	B2	3/2013	Bonanno et al.	
2002/0100851	A1 *	8/2002	Abramowsky et al.	248/284.1
2003/0190219	A1 *	10/2003	Young	414/11
2006/0208240	A1 *	9/2006	Spittle et al.	254/8 B
2007/0104558	A1	5/2007	Narelli	
2010/0207085	A1 *	8/2010	Thurm	254/2 C

## OTHER PUBLICATIONS

International Searching Authority, Form PCT/ISA/237, Written Opinion of the International Searching Authority regarding International Application No. PCT/US2014/031956, 6 pages, Jul. 30, 2014.

Vacuflifter, Drywall Lifter, screen shots of video uploaded on Jun. 10, 2011 and viewable from the World Wide Web address <https://www.youtube.com/watch?v=CCiKJUprmk8> on Aug. 14, 2014.

All-Vac-Lift, All-Vac-Lift for wood, downloaded from the World Wide Web at <http://web.archive.org/web/20090107052734/http://www.vac-lift.com/wood.html>, dated Jan. 7, 2009, 5 pages.

All-Vac-Lift, VacLift PL180, downloaded from the World Wide Web at <http://web.archive.org/web/20110503073434/http://www.vac-lift.com/180.html>, dated May 3, 2011, 7 pages.

All-Vac-Lift, All-Vac-Lift for plates, downloaded from the World Wide Web at <http://web.archive.org/web/20110503073608/http://www.vac-lift.com/plates.html>, dated May 3, 2011, 5 pages.

Grainger Inc., Scissor Lift Cart, 400 lb., Steel, Tilt, 3 pages, downloaded from the World Wide Web at <http://www.grainger.com/Grainger/Scissor-Lift-Cart-2TKY6>, Apr. 3, 2013.

Harbor Freight Tools, Pittsburgh Automotive Air/Hydraulic Bottle Jack—Owner's Manual & Safety Instructions, 16 pages, Jul. 21, 2011.

Venturi Jet Pumps Ltd, Air Ejectors, 1 page, downloaded from the World Wide Web at <http://www.venturipumps.com/airejector.htm>, Apr. 12, 2013.

Wikipedia, Mechanical Joint, 8 pages, downloaded from the World Wide Web at [http://en.wikipedia.org/wiki/Mechanical\\_joint](http://en.wikipedia.org/wiki/Mechanical_joint), Jun. 21, 2013.

Coval Inc., Heavy duty in-line ejectors, VR 05, 07, 09 series, and Ejector Fittings, VR 10, 12, 14, series, 4 pages, Mar. 19, 2012.

Coval Inc., High-performance suction pads, C series, 3 pages, Mar. 19, 2012.

The Incredible Hoist, Photo Gallery, 2 pages, downloaded from the World Wide Web at <http://www.incrediblehoist.com/>, Apr. 12, 2013.

Numatics, Inc., Numatics Vacuum Products, Emerson Industrial Automation, 85 pages, Mar. 2012.

Blickle Rader+Rollen GMBH U. Co. KG., Wheels and Castors Guide, Basics / Terminology, 1 page, Jan. 27, 2012.

Manufacturer Express, Inc., Ratchet Strap, 2 pages, downloaded from the World Wide Web at <http://www.mfexpress.com>, Jun. 20, 2013.

\* cited by examiner

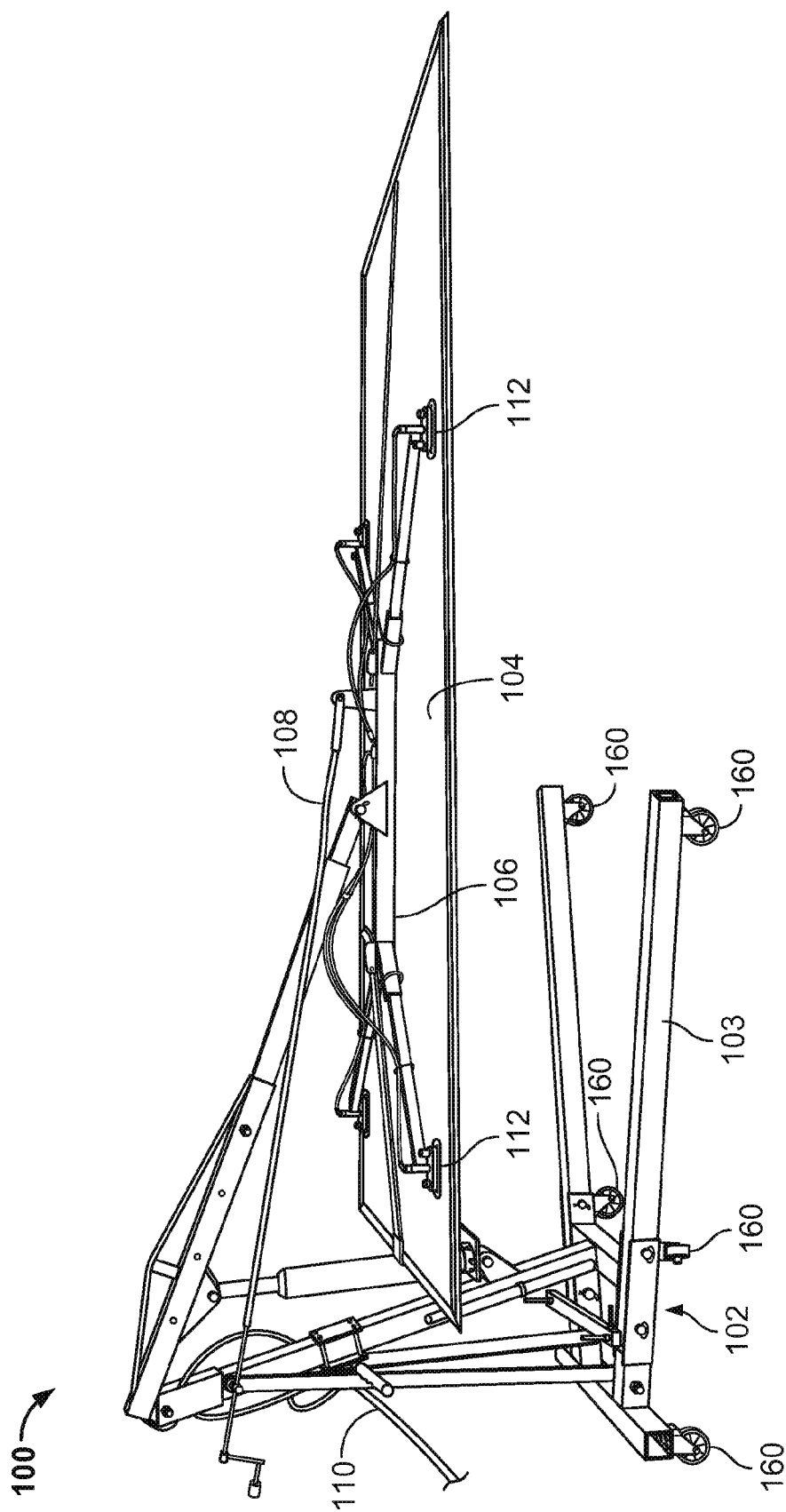


FIG. 1

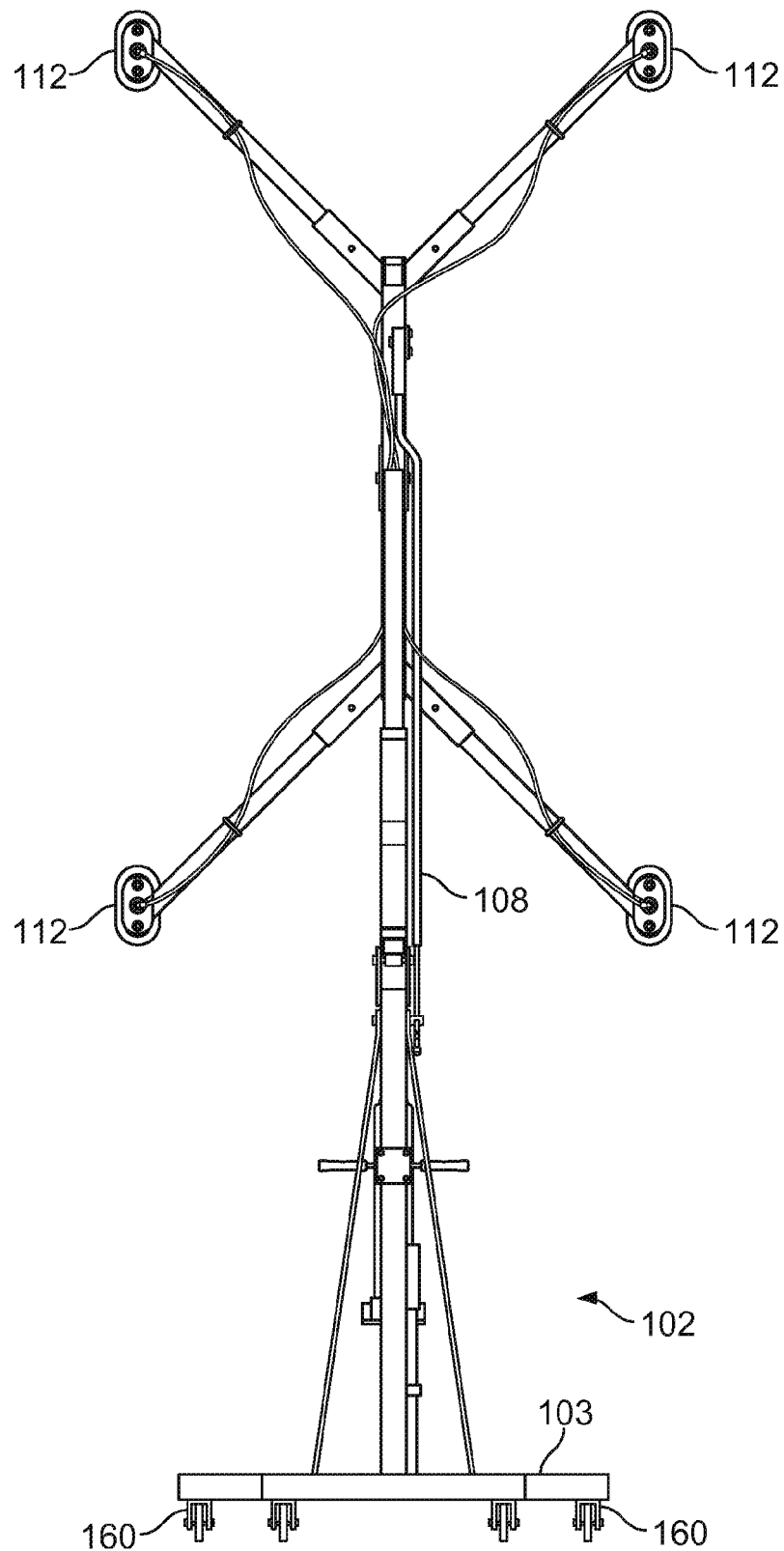


FIG. 2

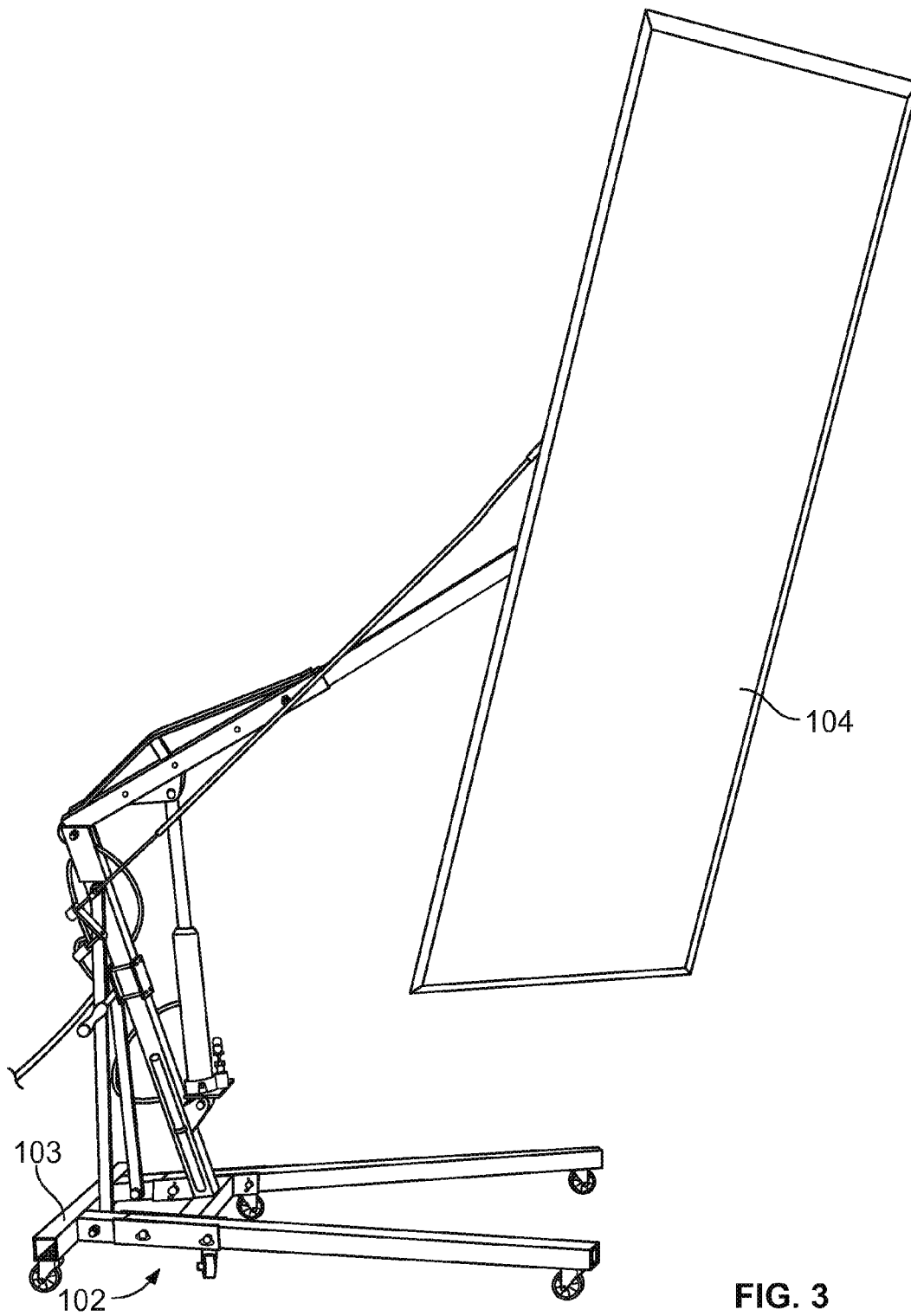


FIG. 3

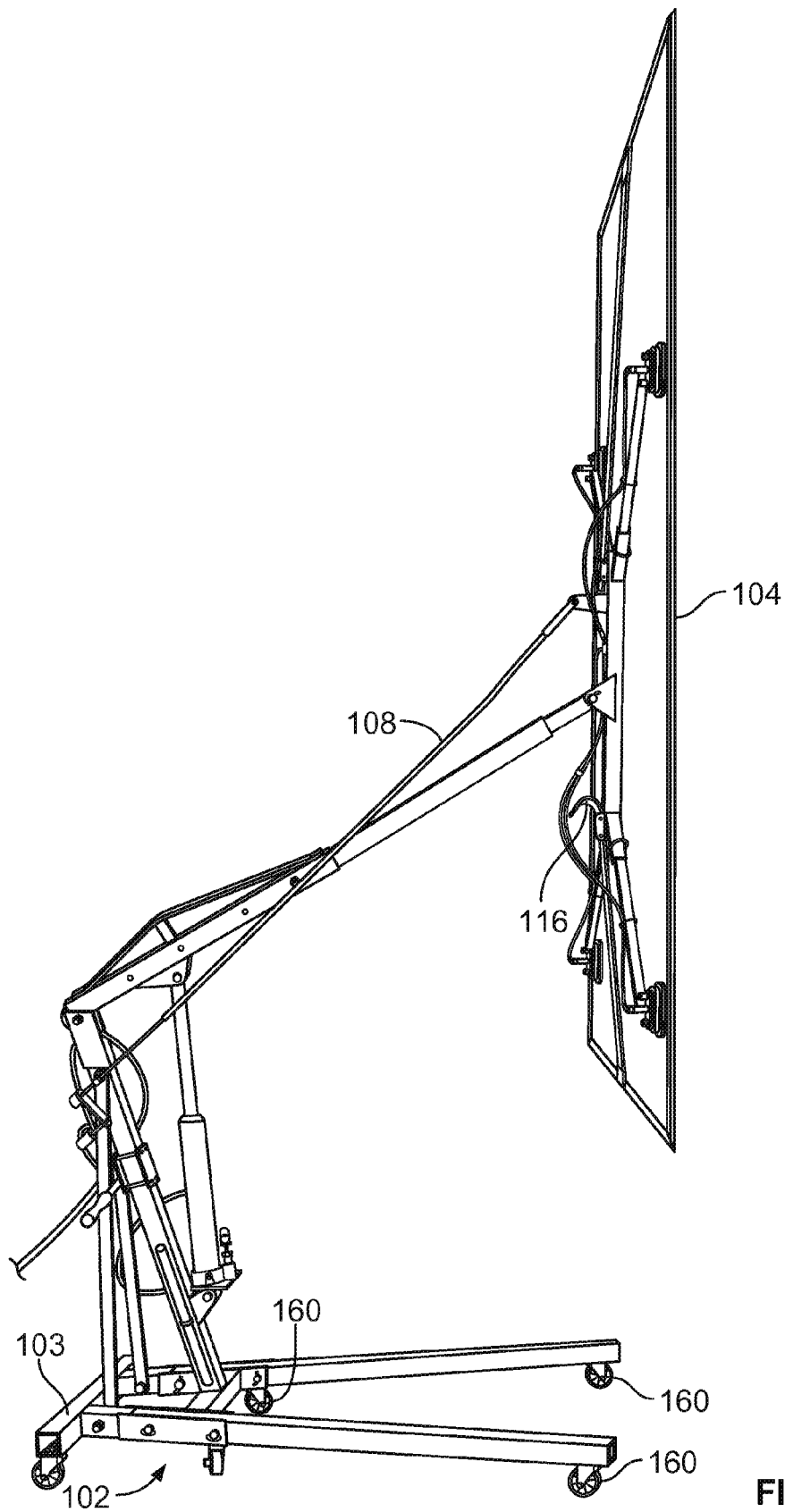


FIG. 4

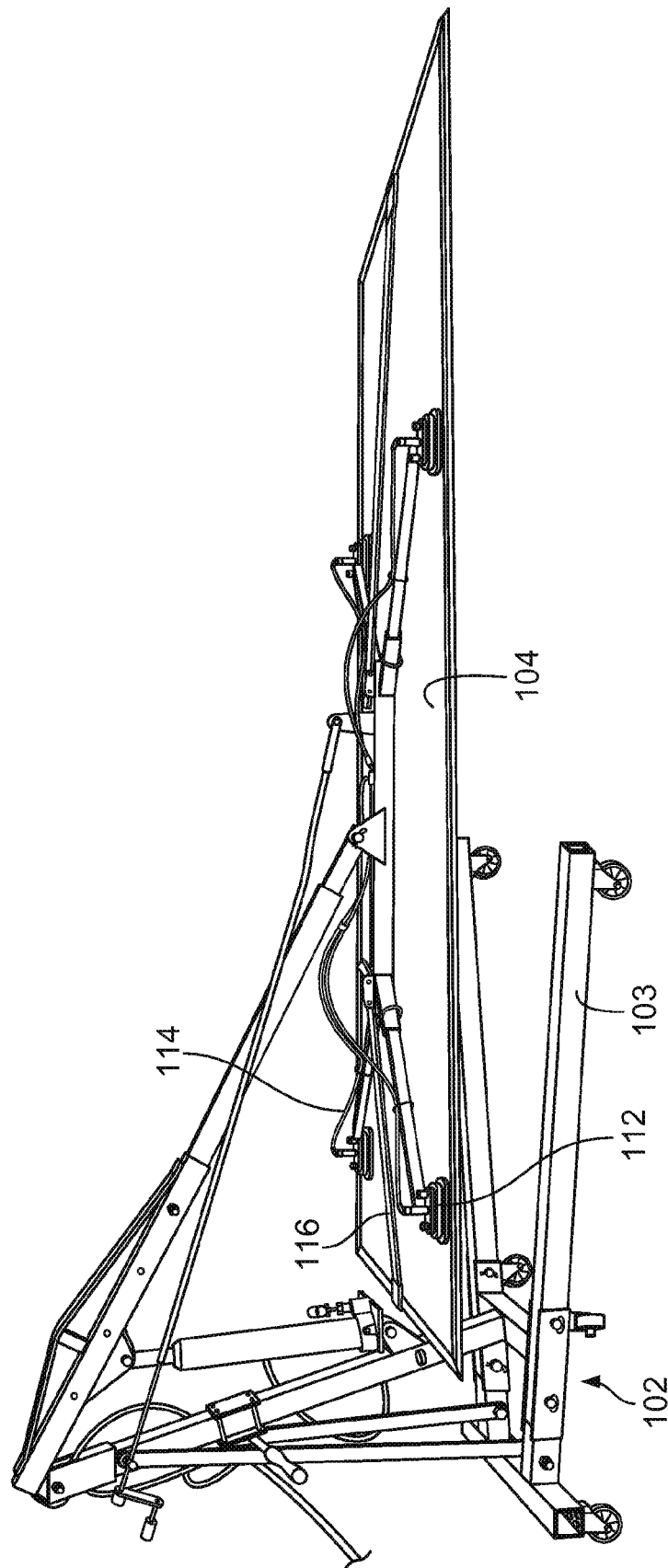


FIG. 5

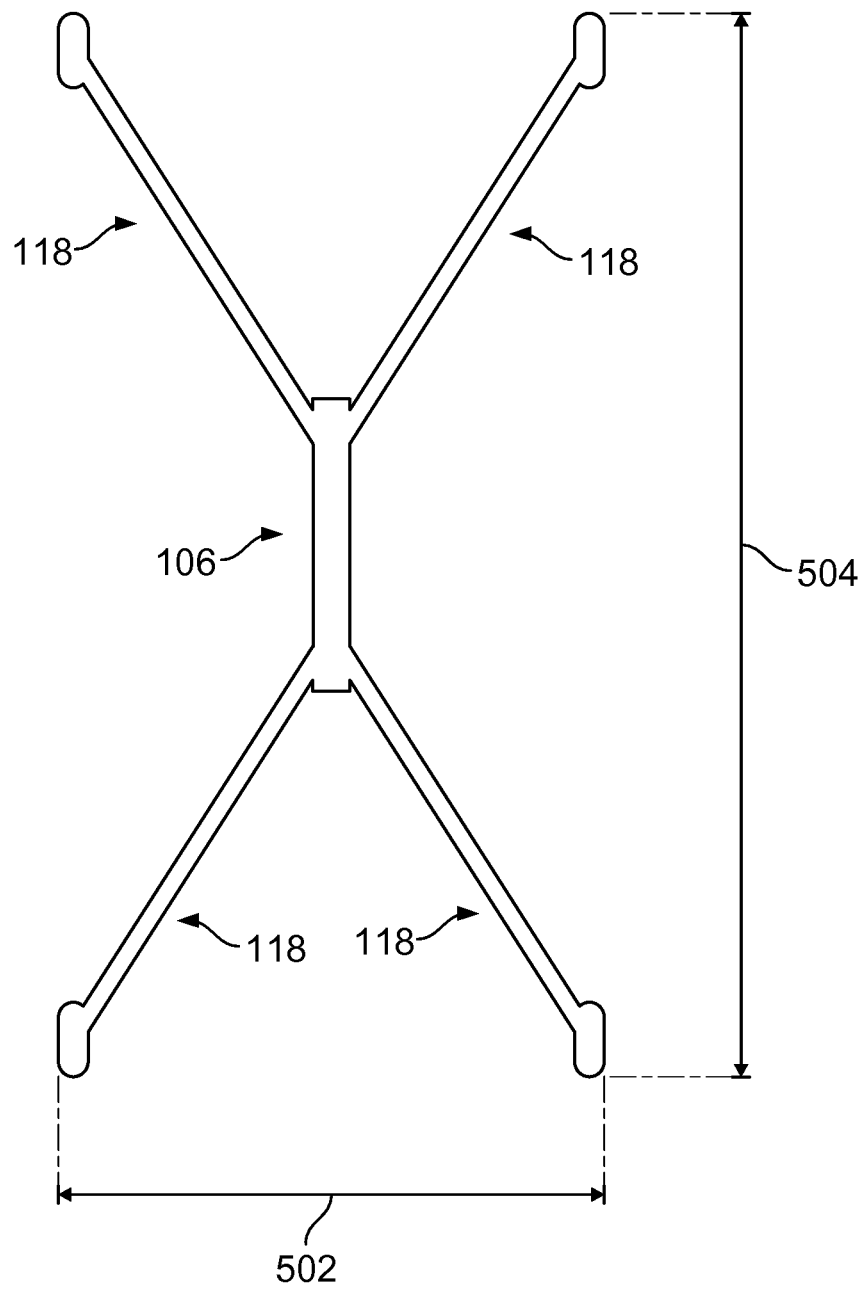


FIG. 6



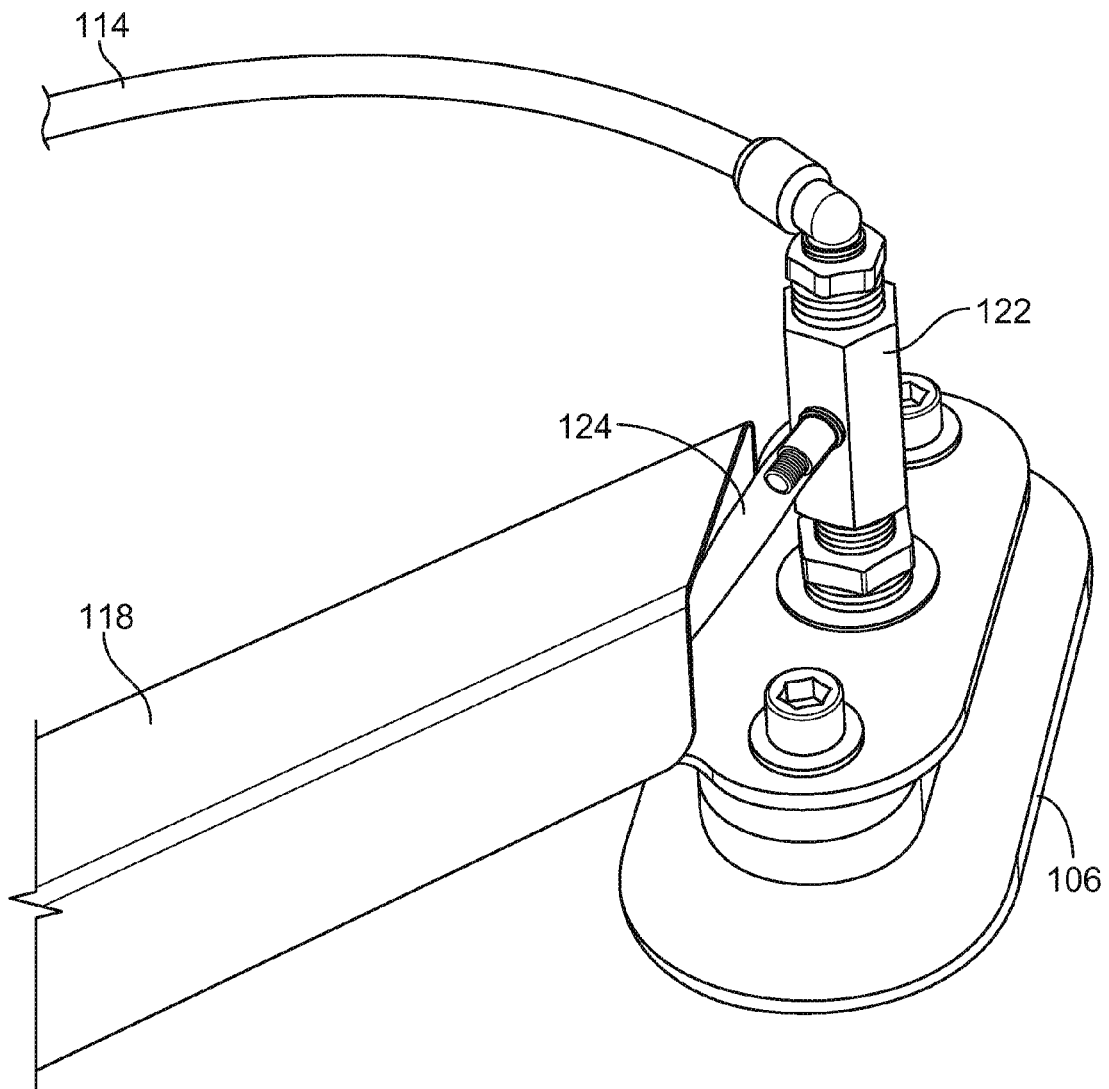


FIG. 7

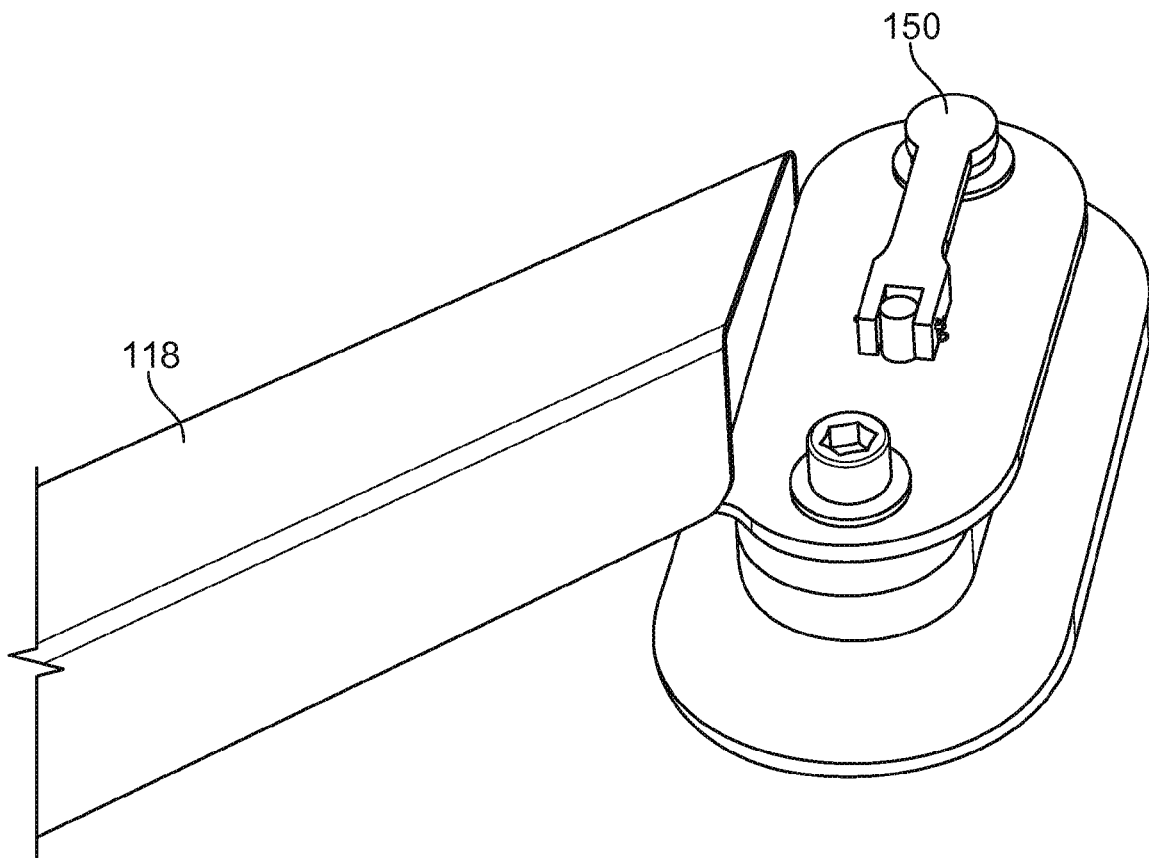


FIG. 8

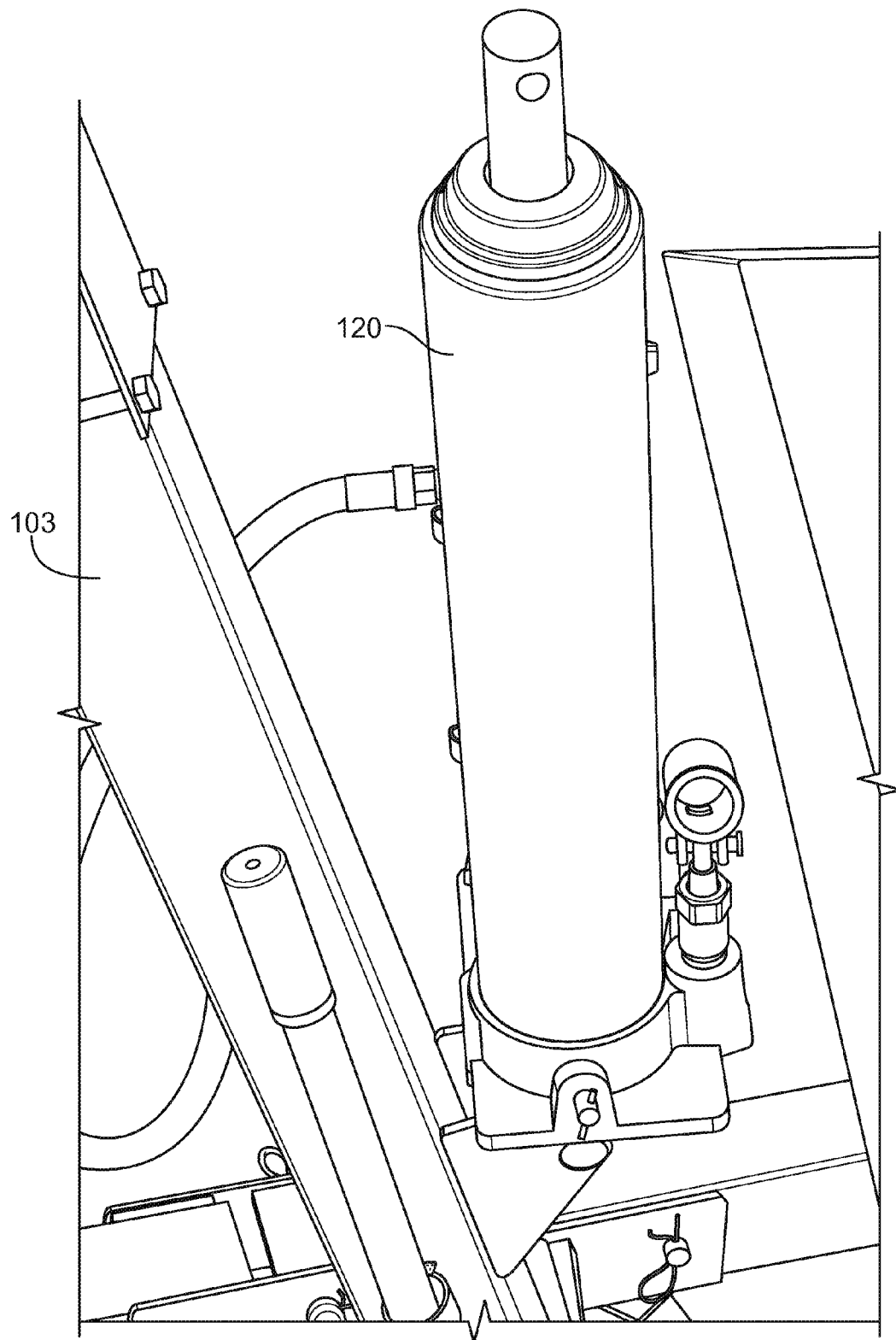


FIG. 9

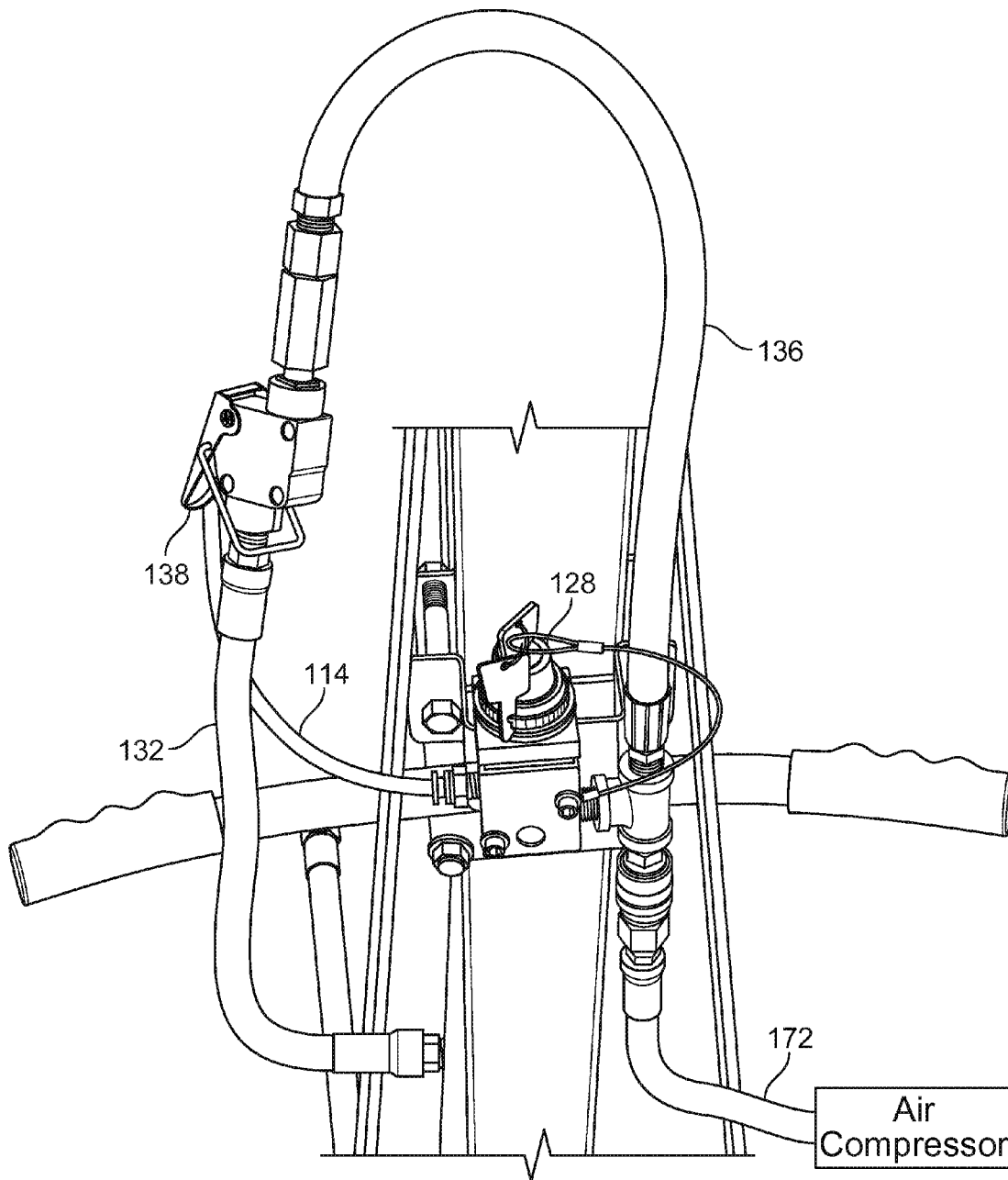


FIG. 10

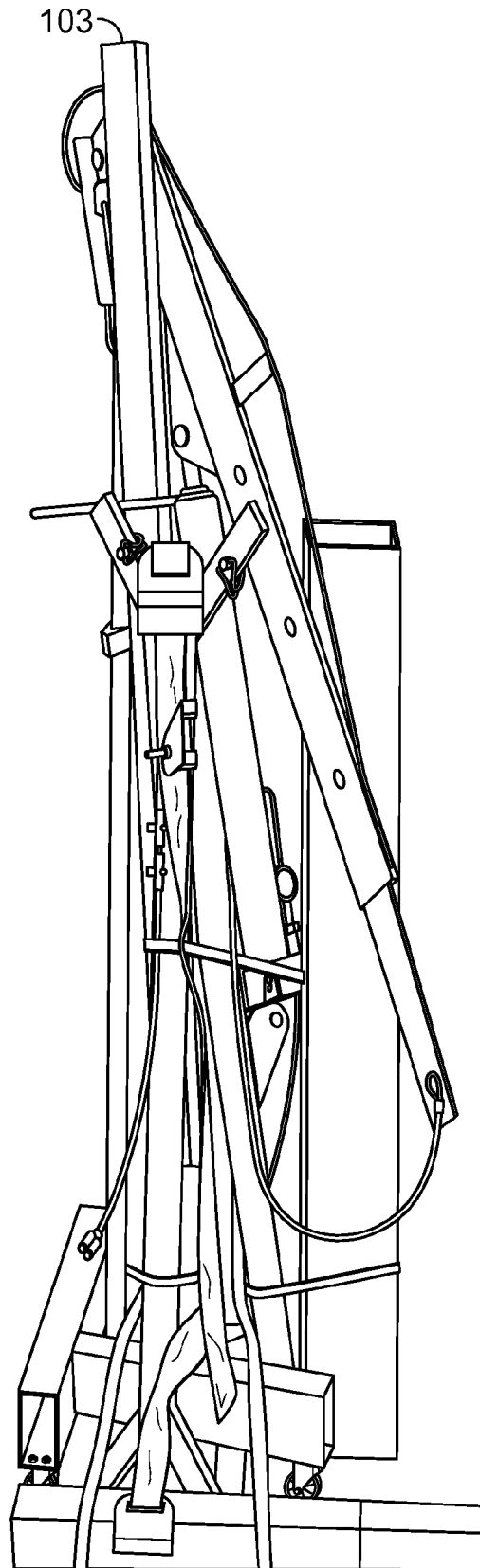


FIG. 11

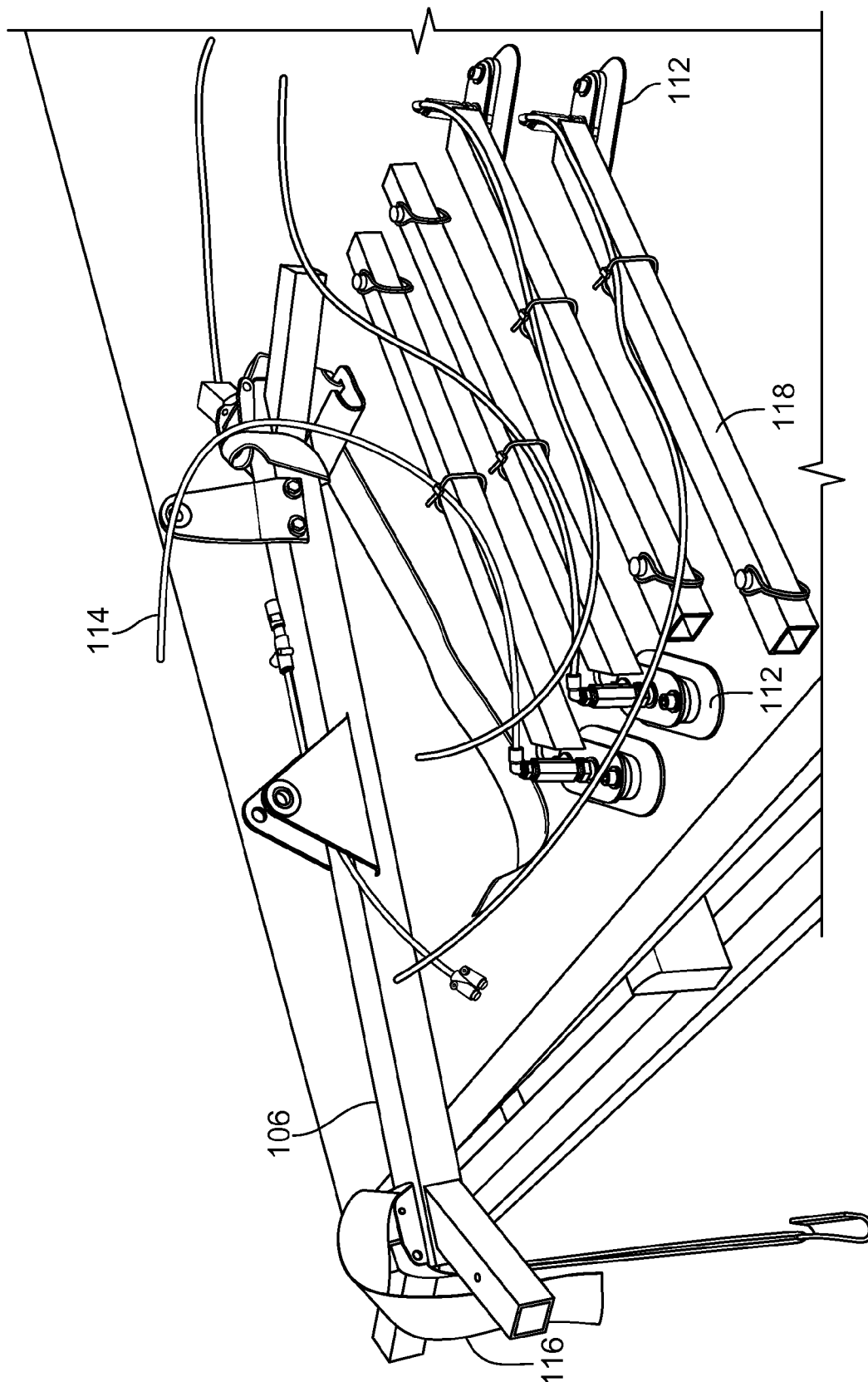


FIG. 12

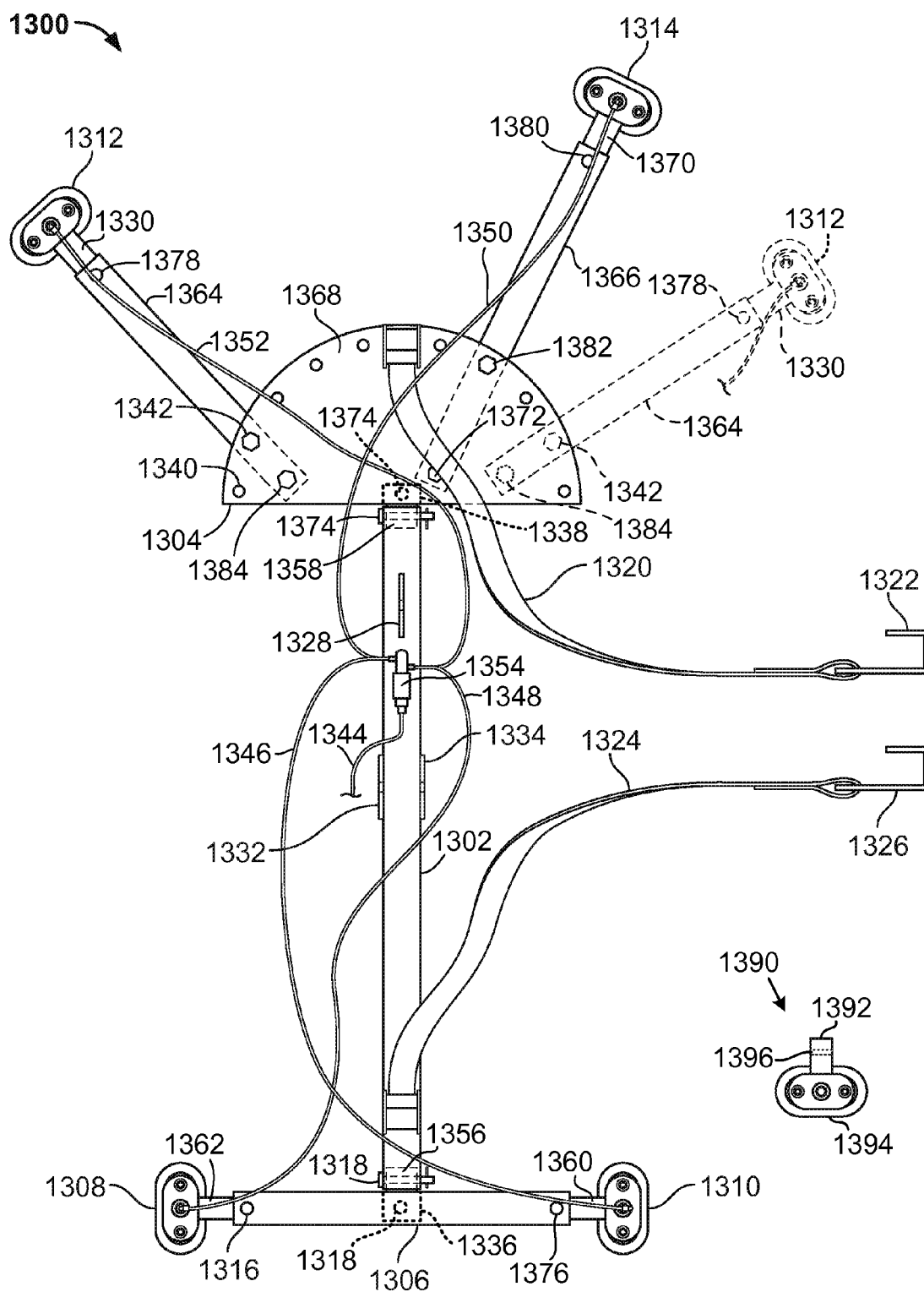
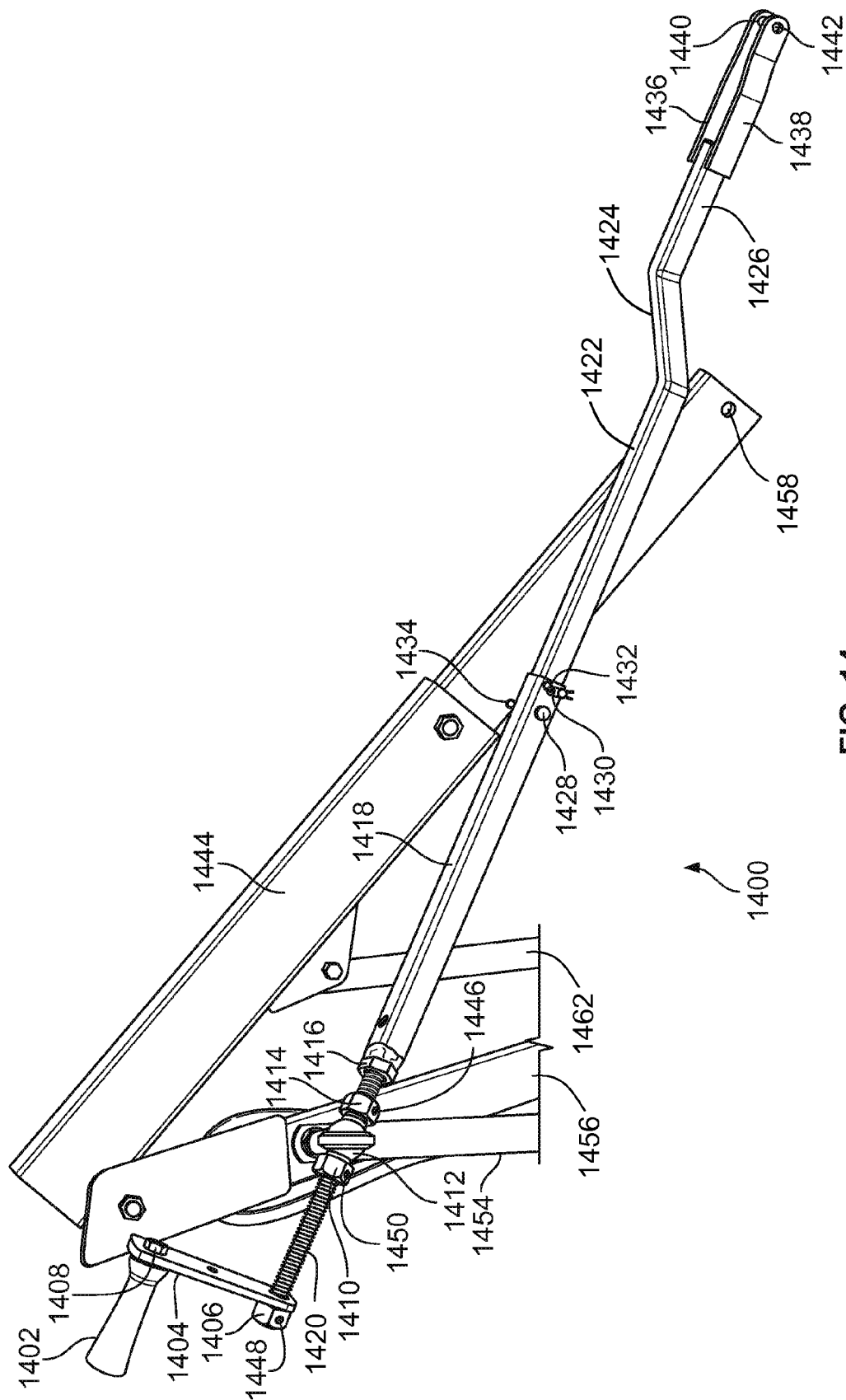


FIG. 13



**FIG. 14**



## 1

## PANEL HOIST

This application claims the benefit of U.S. Provisional Patent Application No. 61/807,746, filed Apr. 2, 2013. U.S. Provisional Patent Application No. 61/807,746 is incorporated herein by reference.

## BACKGROUND

Panels, such as door panels and side panels of a semi-tractor trailer, are produced in a variety of configurations. The various configurations can differ, in part, based on the size and weight of the panels. Lifting and holding panels while attaching the panels to a panel attachment item such as a wall or a semi-tractor trailer can be a job that requires multiple people to lift and hold the panel while one or more other people attach the panel to the panel attachment item. It would be beneficial to reduce the number of people required to maneuver, attach, and remove panels.

## OVERVIEW

Example embodiments are described herein. In one respect, an example embodiment can take the form of a panel hoist comprising: (i) a base, (ii) a hoist arm connected to the base, (iii) a jack configured to raise and lower the hoist arm, (iii) a panel holder, (iv) a rotator configured to rotate the panel holder, (v) a first rotatable joint that connects the hoist arm to the panel holder, and (vi) a second rotatable joint that connects the rotator to the panel holder.

In another respect, an example embodiment can take the form of a kit comprising: (i) a panel holder, (ii) a rotator configured to rotate the panel holder, (iii) a first rotatable joint adapted to be connected to the panel holder and to a hoist arm of a hydraulic engine lift, (iv) a second rotatable joint adapted to connect the rotator to the panel holder, and (v) a plurality of suction cups adapted for connection to the panel holder.

These as well as other aspects and advantages will become apparent to those of ordinary skill in the art by reading the following detailed description, with reference where appropriate to the accompanying drawings. Further, it should be understood that the embodiments described in this overview and elsewhere are intended to be examples only and do not necessarily limit the scope of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

Example embodiments are described herein with reference to the drawings, in which:

FIG. 1 shows a panel hoist holding a panel in accordance with one or more example embodiments;

FIG. 2 shows a panel hoist holding a panel in accordance with one or more example embodiments;

FIG. 3 shows a panel hoist with a panel holder in an elevated position relative to a lowest position of the panel holder;

FIG. 4 shows a panel hoist holding a panel in accordance with one or more example embodiments;

FIG. 5 shows a panel hoist holding a panel in accordance with one or more example embodiments;

FIG. 6 shows a panel holder configuration in accordance with one or more example embodiments;

FIG. 7 shows details of a panel holder in accordance with one or more example embodiments;

FIG. 8 shows details of a panel holder in accordance with one or more example embodiments;

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FIG. 9 shows details of a panel hoist in accordance with one or more example embodiments;

FIG. 10 shows additional details of a panel hoist in accordance with one or more example embodiments;

FIG. 11 shows additional details of a panel holder in accordance with one or more example embodiments;

FIG. 12 shows a panel hoist in an example configuration for shipment of the panel hoist;

FIG. 13 shows details of an alternative panel holder in accordance with one or more example embodiments; and

FIG. 14 shows details of a panel rotator in accordance with one or more example embodiments.

## DETAILED DESCRIPTION

## I. Introduction

This description describes a panel hoist (or more simply, a “hoist”) in accordance with one or more example embodiments. This description also describes various alternative arrangements of the panel hoist example embodiments.

The panel hoists described herein can be used to perform any of a variety of operations including, but not limited to, handling, repositioning, lifting, raising, carrying, transporting, or lowering a panel or panel-like item. The panel or panel-like item can comprise any of a variety of items including, but not limited to, a door, a side panel, floor panel, or ceiling panel of a semi-tractor trailer, a board (for example, a long, thin, piece of wood or other hard material), a glass panel, a fiberglass panel, or a sheet of metal. By way of example, the board can comprise a cement board, a drywall board, or a sheet of plywood. A door can comprise, but is not limited to, a door configured for attachment to or removal from a van or tractor trailer. A panel hoist useable or used with respect to doors can be referred to as a door handling tool.

In this description, the articles “a” or “an” are used to introduce elements of the example embodiments. The intent of using those articles is that there is one or more of the elements. The intent of using the conjunction “or” within a described list of at least two terms is to indicate any of the listed terms or any combination of the listed terms. The use of ordinal numbers such as “first,” “second,” “third” and so on is to distinguish respective elements rather than to denote a particular order of those elements.

This description describes one or more components as being “removably attached” or “removably attachable.” The terms “removably attached” and “removably attachable” and other forms thereof indicate that the component can be attached to one or more other components and subsequently removed from any or all of the one or more other components. Removably attachable components can be attached and removed multiple times. Any two or more components described in this description or shown in any figure as being connected or attached can be removably attached.

The images shown in the figures are provided merely as examples and are not intended to be limiting. Many of the elements illustrated in the figures or described herein are functional elements that can be implemented as discrete or distributed components or in conjunction with other components, and in any suitable combination and location. Those skilled in the art will appreciate that other arrangements and elements (e.g., machines, interfaces, functions, orders, or groupings of functions) can be used instead.

## II. Example Architecture

FIG. 1 shows a panel hoist **100** holding a panel **104** in accordance with one or more example embodiments. As

shown in FIG. 1, panel **104** is rectangular in shape, although other panels that panel hoist **100** can hold may be a shape other than rectangular. The rectangular panel **104** has a longitudinal axis extending between gripper clips. The rectangular panel **104** also has a transverse axis perpendicular to the longitudinal axis.

Panel hoist **100** includes a base **102**. As shown in FIG. 1, base **102** includes base-elements, which, for example, can comprise rectangular steel tubes or pipes. Alternatively, base-elements can be made of a material other than steel, or can have a non-rectangular shape, such as a circular shape. Furthermore, instead of using tubes or pipes, base-elements can comprise solid (non-hollow) legs. Base-elements can be formed with or drilled to include holes in various locations to accept fasteners (e.g., screws or bolts) for connecting other elements of panel hoist **100** to base-elements.

Panel hoist **100** includes a hoist arm, and a hoist arm support to connect hoist arm to base **102**. Panel hoist **100** can include stabilizers to stabilize hoist arm support. Stabilizer can attach to base-element **103** using a fastener, such as a bolt and nut. Stabilizer can be similarly attached to base-element.

Hoist arm support can be attached to base-element in any of a variety of manners. As an example, hoist arm support can be welded to base-element. As another example, hoist arm support can slide over or into an extender-element (not shown) extending from base-element. A fastener, such as a pin or clevis pin, can be positioned within holes in hoist arm support and the extender-element to secure hoist arm support to base-element.

Panel hoist **100** can comprise a jack **120** to raise hoist arm. Hoist arm support can include a jack support to support jack **120**. Jack **120** can, for example, comprise a hydraulic jack, an air-over-hydraulic jack, or an electric-over-hydraulic jack. A jack can be used to lift items.

Panel hoist **100** includes a panel holder **106** configured for holding a panel, such as panel **104**. Holding panel **104** can include holding the panel above the floor or ground on which panel hoist **100** is located. Panel holder **106** provides means for panel **104** to be removably attached to panel hoist **100**. A panel holder, especially one used to hold doors, can be called a door holder.

Panel hoist **100** can include a rotator **108**. Rotator **108** can include a handle and is configured for rotating panel holder **106** and a panel, such as panel **104**, held by panel holder **106**. Rotator **108** provides for maneuvering (e.g., rotating) panel **104** from a horizontal to a vertical position, from a vertical position to a horizontal position, or to any position between a vertical position and a horizontal position. Rotator **108** can be called a crank assembly. Rotator **108** can be configured like rotator **1400** shown in FIG. 14.

Panel holder **106** can include attachment bracket. Attachment bracket can be welded or otherwise attached to panel holder **106**. Attachment bracket can include or can be attached to a mechanical joint to which hoist arm attaches. For purposes of this description, that mechanical joint is referred to as a hoist arm mechanical joint. Hoist arm can be unattached from the hoist arm mechanical joint, the attachment bracket, and the panel holder **106**. Hoist arm and attachment bracket can include one or more through-holes through which a fastener, such as a clevis pin or nut and bolt, can be inserted to secure the attachment of hoist arm to attachment bracket. The hoist arm mechanical joint can be configured as a knuckle joint. The hoist arm mechanical joint can include a bushing and rotatable roller pin. The roller pin can comprise a clevis pin. The roller pin can include a through-hole for

placement of a cotter pin to retain the roller pin within an attachment hole or bushing. The mechanical joints described herein can be rotatable joints.

Panel holder **106** can include attachment bracket. Attachment bracket can be welded or otherwise attached to panel holder **106**. Attachment bracket can include or can be attached to a mechanical joint to which rotator **108** attaches. For purposes of this description, that mechanical joint is referred to as a rotator mechanical joint. Rotator **108** can be unattached from the rotator mechanical joint, the attachment bracket, and the panel holder **106**. Rotation of rotator **108** can cause rotator **108** to pivot about a component of the rotator mechanical joint. Rotator **108** and attachment bracket can include one or more through-holes through which a fastener, such as a clevis pin or nut and bolt, can be inserted to secure the attachment of rotator **108** to attachment bracket. The rotator mechanical joint can be configured as a knuckle joint. The rotator mechanical joint can include a bushing and rotatable roller pin. The roller pin can comprise a clevis pin. The roller pin can include a through-hole for placement of a cotter pin to retain the roller pin within an attachment hole or bushing.

Panel hoist **100** can include an air delivery system configured to receive supply air (e.g., compressed air) and to provide the supply air to various elements of panel hoist **100**. Various air delivery system components are shown in the Figures and described herein. The air delivery system components shown and labeled in FIG. 1 include an air supply line and air supply inlet lines **114**. The supply air, from an air compressor, can be provided to panel hoist **100** using air supply line.

Panel hoist **100** can include supplemental panel holders **116**. Supplemental panel holders **116** can hold a panel above the floor or ground located beneath base **102**. As an example, supplemental panel holders **116** and panel holder **106** can hold panel **104** in a given position in the event a supply of air to panel hoist **100** is reduced or eliminated. A supplemental panel holder can be called a supplemental door holder or by other names.

A supplemental panel holder **116** can include a gripper clip to clip to an end of panel **104**, a strap connected to gripper clip, and ratchet buckle removably attachable to panel holder **106**. Ratchet buckle can include a ratcheting tensioning mechanism and a tensioning mechanism lever to take up any slack (e.g., adjust) in strap. Gripper clip can comprise a hook, such as a flat hook. Strap can comprise a winch strap or another type of strap. In alternative arrangements, supplemental panel holders **116** can include a cable, rope, or another suitable element in place of a strap.

As shown in FIG. 1, two supplemental panel holders are attached to opposite ends of a portion of panel holder **106**, and straps extend from panel holder **106**, along a longitudinal axis of panel **104**, towards opposing ends of panel **104**. Additionally or alternatively, straps of other supplemental panel holders (not shown) can extend from panel holder **106**, along a transverse axis of panel **104** (i.e., an axis perpendicular to the longitudinal axis), towards other opposing ends of panel **104**.

Panel hoist **100** can comprise a plurality of castors **160** connected to base **102**. One or more of castors **160** can comprise a swivel castor that is vertically rotatable to make panel hoist **100** easier to maneuver. Maneuvering panel hoist **100** can include rolling panel hoist **100** across a floor. One or more of castors **160** can comprise a fixed castor that cannot be vertically swiveled when attached to base **102**. The fixed castor(s) can provide directional stability of panel hoist **100**. Panel hoist **100** can comprise a castor (not shown), similar to castor **160** connected to base-element, connected near an end

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of base-element opposite the end of base-element at which castor **160** is shown in FIG. 1. Castors **160** can be connected to base **102** using fasteners (e.g., bolts or screws), by welding a portion of the castor to base **102**, or using some other means.

In accordance with one or more example embodiments, panel hoist can include a base device that includes two or more of the panel hoist components shown in FIG. 1. The base device can comprise a lifting device, such as an automobile engine lift, that includes the two or more panel hoist components. An automobile engine lift can comprise an engine lift with a capacity of lifting two tons (i.e., 4,000 pounds) or some other capacity. An engine lift can be called a cherry picker. An engine lift with a two ton capacity can be called a two ton engine lift or a two ton rolling engine lift. An engine lift can include a hydraulic jack, an air over hydraulic pump jack, an electric-over-hydraulic jack, or another type of jack.

Turning to FIG. 5, FIG. 5 shows additional details of panel hoist **100** and shows panel hoist **100**, panel holder **106**, and supplemental panel holder **116** holding panel **104** above a floor or the ground on which panel hoist **100** is positioned. A person comparing FIG. 1 to FIG. 5 would see that the position of panel **104** in FIG. 5 is closer to the floor or the ground relative to the position of panel **104** with respect to the floor or ground as shown in FIG. 1.

The lower position of panel **104** in FIG. 5 provides for showing additional details of jack **120**. As shown in FIG. 5, jack **120** includes a handle bracket, a release valve, a jack ram (e.g., a hydraulic piston), and a jack base. Jack base can be attached to jack support. Ram can be attached to hoist arm. Panel hoist **100** can comprise a jack handle to insert into handle bracket for operating a pump plunger (not shown) of jack **120**. Supply air, provided to an air motor of an air-over-hydraulic jack, can be used to raise ram and hoist arm. In an alternative arrangement, supply air can be provided by an electric powered air compressor (not shown), to the air motor and to the suction cups and air delivery system described elsewhere herein. The electric powered air compressor can connect to an alternating current (AC) voltage source, such as voltage source supplying 110 volts AC.

As mentioned above, hoist arm support can slide over or into an extender-element extending from base-element. FIG. 5 shows an extender-element into which a portion of hoist arm support has been positioned. The fasteners that can be used to retain hoist arm support within extender-element are not shown.

One or more base-elements **103** can comprise multiple base-element segments. The base-element segments of each base-element can attach to one another to form a complete base-element. The base-element segments can be detached from one another during disassembly of the base-element and panel hoist **100**. As shown in FIG. 5, base-element **103** includes base-element segments. As an example, a portion of base-element segment can be positioned within base-element segment. As another example, a portion of base-element segment can be positioned within base-element segment. One or more fasteners, such as fasteners can be inserted within base-element segments to retain those segments together. Support elements can abut base-element segments to retain those segments together. Base-element **109** can be configured similar to base-element **103**.

Turning to FIG. 2, FIG. 2 illustrates panel hoist **100** without panel **104**, but with panel holder **106** in an elevated and rotated position relative to the position of panel holder **106** as shown in FIG. 1 and FIG. 5. FIG. 2 shows handles attached to hoist arm support. Handles can be used for maneuvering panel hoist **100**. Handles provide for pushing and pulling of panel hoist **100**.

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FIG. 2 also shows an alternative arrangement of panel holder **106** in which panel holder **106** includes flanges proximate to suction cups **112** or otherwise. Each flange can comprise a through-hole. In the event a panel to be held is damaged such that one or more suction cups **112** cannot be attached to the damaged panel, bolts or other fasteners can be placed through the flange holes and holes in the damaged panel and secured with nuts to attach the damaged panel to panel hoist **100**. As an example, the damaged panel can comprise a damaged door to be removed from a van or trailer. The damaged panel can subsequently be lowered from its mounted position, removed from panel hoist **100**, and then a replacement panel can be attached to panel hoist **100**, raised to a mounting position, and attached to the van or trailer the panel in place of the damaged panel.

Turning to FIG. 4, FIG. 4 illustrates panel hoist with panel **104** and panel holder **106** in an elevated and rotated position relative to the position of panel holder **106** as shown in FIG. 1 and FIG. 2. FIG. 4 shows labels for defining portions of panel **104**. In that regard, panel **104** includes a first end, a second end, a third end, and a fourth end. First end can be called a top. Second end can be called a bottom.

As shown in FIG. 4, as compared to FIG. 1, ram has been extended to raise hoist arm such that panel **104** has been raised from its initial height, and rotator **108** has been turned to rotate panel **104** such that its longitudinal axis is substantially perpendicular to the floor or ground upon which base **102** is positioned. The longitudinal axis extends from first end to second end. The transverse axis of panel **104** extends from third end to fourth end.

Turning to FIG. 4, FIG. 4 illustrates panel hoist with panel **104** and panel holder in an elevated and rotated position relative to the position of panel holder **106** as shown in FIG. 1 and FIG. 5. Suction cups **112**, supplemental panel holders **116**, and gripper clips holding panel **104**, all of which are discussed above, are identified in FIG. 2.

As shown in FIG. 4, hoist arm can comprise multiple hoist arm segments. Two of the hoist arm segments can attach to one another to form a larger portion of hoist arm. Hoist arm segment includes fastener slots and another fastener slot in which a fastener is inserted. Fastener can, for example, comprise a clevis pin and retainer pin, or a bolt and nut. A portion of hoist arm segment can be positioned within hoist arm segment. While in that position, an end of hoist arm segment can be located between fastener slot and fastener. To change a length of hoist arm, after removing fastener, the end of hoist arm segment can be slid to another portion within hoist arm segment and fastener can be placed within another fastener slot within hoist arm segment to fasten hoist arm segment to hoist arm segment.

Hoist arm segments can be welded together. Alternatively, each of those hoist arm segments can include fastener slots, usable with a fastener, to adjust a length of a portion of hoist arm formed by hoist arm segments.

Turning to FIG. 6, FIG. 6 shows an example X-frame configuration (or more simply, "X-frame") of panel holder **106**. X-frame configuration includes four arms **118** extending from a common center portion. A suction cup can be positioned at or proximate to a distal end of each arm **118** relative to the common center portion. Panel hoist **100** can use four air-actuated suction cups **112**. As an example, each suction cup can comprise a 2.5 inch by 5 inch suction cup. Other example sizes of the suction cups are also possible. The suction cups positioned on each arm **118** can be configured like suction cups **112** identified in FIG. 1, FIG. 2, and FIG. 5. Panel holder **106**, using X-frame configuration, can attach to hoist arm using attachment bracket, as described herein.

X-frame configuration can be configured to be removably attachable to an end of an engine lift.

FIG. 6 shows panel holder 106 having dimensions 502 and 504. As an example, dimension 504 can be 72 inches and dimension 502 can be 44 inches. Other examples of dimensions 502 or 504 are also possible. In that regard, for example, an arm 118 can comprise a telescoping arm to increase or decrease a length of the arm. To shorten the arm, a first portion of the arm 118 can slide into a second portion of the arm. A pin or other device can be inserted into holes within the first and second portions of arm 118 to keep arm 118 at a fixed length until the length of arm 118 is readjusted. To lengthen arm 118, the first portion of arm 118 can be pulled out of the second portion of arm 118. The pin or other device can be inserted into holes within the first and second portions of arm 118 to keep arm 118 at another fixed length until the length of arm 118 is readjusted.

A person having ordinary skill in the art will understand that panel holder 106 can be arranged in any of a variety of configurations including configurations other than X-frame configuration. At least one of those other configurations can comprise a configuration with a number of arms other than four arms.

Turning to FIG. 7, FIG. 7 shows details of panel holder and arm 118 in accordance with one or more example embodiments. Any or all of arms 118 shown in FIG. 6 may be arranged as shown in FIG. 7. FIG. 7 shows a distal end of arm 118, a suction cup mounting portion, a suction cup attached to suction cup mounting portion using fasteners, and a venturi vacuum device 122 attached to a venturi vacuum device mounting area 708 of suction cup mounting portion. Fasteners can comprise any of a variety of fasteners.

An air supply inlet line 114 provides supply air to a venturi vacuum device 122. An air return line 124 is connected to venturi vacuum device 122 to remove supply air exiting venturi vacuum device 122. Air supply inlet line 114 and venturi vacuum device 122 can be components of the air delivery system described herein.

Suction cup 112 can comprise an air actuated 27 Hg vacuum suction cup. Each suction cup 112 can be rated at 117 pounds of lifting force. Supply air, such as compressed air provided by a shop air compressor of the air delivery system, can be provided to an air pump to create a vacuum at the suction cups to secure the suction cups to the door. Using an air over hydraulic pump, an arm of panel hoist 100 can be raised, with panel 104 attached to panel holder 106, to a position at which panel 104 can be rotated using rotator 108 from a horizontal or substantially horizontal position to a vertical or substantially vertical position.

Turning to FIG. 8, FIG. 8 shows details of panel holder and arm 118 in accordance with one or more example embodiments. Any or all of arms 118 shown in FIG. 6 may be arranged as shown in FIG. 8. FIG. 8 shows a distal end of arm 118, a suction cup mounting portion, a suction cup attached to suction cup mounting portion using fasteners, and a mechanical lever 150 attached to a lever mounting area of suction cup mounting portion. Fasteners can comprise any of a variety of fasteners. Mechanical lever 150 can be configured for securing suction cup to panel 104, and releasing a suction cup that is secured to panel 104. The arrangement of suction cup 112 can be referred to as a manual suction cup. A manual suction cup does not require use of electricity or a compressed air supply to apply the suction cup to a panel to be held by panel hoist 100.

Turning to FIG. 9, FIG. 9 shows details of panel hoist including base-element, hoist arm support 103, jack handle, handle bracket, jack 120, release valve, jack support 127, and

ram 194. FIG. 9 shows jack 120 as an air over hydraulic jack including air motor. The air motor can include or work in combination with an air over hydraulic pump to raise ram. The air supply line 132 shown in FIG. 10 is shown in FIG. 9 leading to jack 120. In accordance with other embodiments, the jack can be limited to a hydraulic jack. As shown in FIG. 9, base-element includes base-element segments, support elements, and fasteners to retain base-element segments to support elements until disassembly of base-element 109.

Turning to FIG. 10, FIG. 10 shows example components of panel hoist and, in particular, air delivery system components of panel hoist 100. FIG. 10 shows hoist arm support, stabilizers, and handles to show example locations at which various air delivery system components can be attached to panel hoist 100.

The air delivery system can include air supply line that is removably attachable to an air compressor. The air delivery system can include air supply line fittings. Air supply line fitting provides a means to connect panel hoist 100 to a source of compressed air (e.g., air compressed above the ambient air pressure), such as air compressor. As an example, air compressor can provide compressed air between a range of 125 to 180 pounds per square inch. Other example air pressures are also possible.

The air delivery system can include a keyed switch 128 to switch the supply of air to venturi vacuum devices 122 (shown in FIG. 7) at each suction cup 112 by way of air supply inlet lines 114, and to air motor of an air-over-hydraulic jack 120 (shown in FIG. 9). The use of the keyed switch or another safety switch can help to avoid removal of supply air to venturi vacuum devices 122 and air motor of an air-over-hydraulic jack 120, including when panel 104 is raised above the ground.

The air delivery system can include an air control switch 138 connected to air supply lines 132 and 136. Supply air provided to air supply line 136 can flow to air control switch 138. Air control switch 138 can be used to supply air to air motor by way of air supply line 132 so as to raise ram of jack 120.

The air delivery system can include an air pressure regulator to control an amount of air pressure provided to various components of the air delivery systems, such as venturi vacuum devices 122 or air motor.

### III. Panel Hoist Disassembly

Various components of panel hoist 100 have been described as being attached or connected to each other. Some or all of those attached components and other components of panel hoist 100 can be unattached or disconnected from each other and subsequently re-attached or re-connected multiple times. The disassembly of panel hoist 100 provides for easier shipment of panel hoist 100 in the event panel hoist 100 needs to be shipped.

Turning to FIG. 12, FIG. 12 shows various components of panel holder 106 in accordance with one or more example embodiments in which panel holder 106 can be disassembled and reassembled. As shown in FIG. 12, panel holder 106 includes a bracket body. Bracket body includes branches and attachment brackets. Attachment bracket includes bracket segments, both of which can include a bushing. Attachment bracket can include a bushing.

Branches can include attachment holes for receiving a fastener for attaching or retaining a branch extender to a branch of bracket body. Branches can include an external surface and an inner portion. Similarly, branch extender can include an external surface and an inner portion. In one

respect, an end of branch extender opposite suction cup **112** can be placed within an inner portion of a branch. In another respect, a distal end of a branch, relative to bracket body, can be placed within an inner portion of a branch extender. Bracket body, branches and branch extenders can have rectangular cross-sections, as shown in FIG. **12**, or a non-rectangular cross-section.

Each branch can include one or more attachment holes (two of which are shown in FIG. **12**). Each branch extends away from bracket body such that panel holder **106** is configured like the letter "X." That configuration can be referred to as an "X-frame configuration."

Each branch extender includes a suction cup **112**, a venturi vacuum device **122**, a branch extender fastener, a retainer strap, and an attachment hole (not shown because branch extender fasteners are located within those attachment holes). As an example, each fastener can comprise a rounded retainer locking pin having a 0.25 inch diameter and a length of 2.5 inches, or some other type of fastener. The fastener can include a through-hole for installing a cotter pin or other fastener retainer. Retainer straps can be attached to branch extender to reduce the likelihood or prevent separation of branch extender fastener from its respective branch extender.

FIG. **12** shows other components of panel holder **106** or other components that attach to or that are associated with panel holder **106**. Those other components include air supply inlet lines **114**, air supply inlet line retaining straps, supplemental panel holders **116**, air line fittings for connecting segments of air supply inlet lines **114** or other components of the air delivery system, and gripper clips.

Turning to FIG. **11**, FIG. **11** shows panel hoist **100** in a disassembled state and attached to a shipping element, such as a wooden pallet. Mounting straps can be used to keep the disassembled components of panel hoist **100** strapped together for shipment of panel hoist **100**. The various components identified in FIG. **11** are discussed with respect to other similarly numbered components in other figures.

#### IV. Example Kits

In accordance with the example embodiments described herein, a variety of kits comprising components of a panel hoist can be arranged. In one respect, the kit components can be assembled to form a panel hoist. In another respect, the kit components can be assembled to form one or more panel hoist elements of a panel hoist. Various portions of the kits can be combined and packaged as separate kits.

As an example, a kit can comprise panel holder **106**, a plurality of suction cups **112** connected to or adapted for connection to panel holder **106**, rotator **108**, a first rotatable joint adapted to be connected to panel holder **106** and to a hoist arm of a hydraulic engine lift, and a second rotatable joint adapted to connect rotator **108** to panel holder **106**.

Panel holder **106** of the kit can include attachment bracket including the first rotatable joint. Panel holder **106** of the kit can include attachment bracket including the second rotatable joint.

Rotator **108** of the kit can comprise a shaft including a first shaft segment and a second shaft segment. The first shaft segment can include a first end and a second end. The first end of the first shaft segment includes a first threaded portion. The second shaft segment can include a first end and a second end. The first end of the second shaft segment includes a second threaded portion configured to engage the first threaded portion of the first shaft segment. The second end of the second shaft segment is configured for connection to the second rotatable joint.

The example kit can include a secondary panel holder that connects to panel holder **106**. The secondary panel holder can be arranged like secondary panel holder **116**. The secondary panel holder can be connected to panel holder **106**. The secondary panel holder can comprise a first strap, a second strap, a first ratchet tensioner, and a second ratchet tensioner. The first ratchet tensioner and the second ratchet tensioner can be attached to panel holder **106**. A first portion of the first strap is attachable to the first ratchet tensioner and a second portion of the first strap includes a first hook configured for contacting a panel. A first portion of the second strap is attachable to the second ratchet tensioner and a second portion of the second strap includes a second hook configured for contacting the panel. The first ratchet tensioner is operable to increase tension on the first strap. The second ratchet tensioner is operable to increase tension on the second strap.

The example kit can include the hydraulic engine lift.

The example kit can include hoist arm or any portion of hoist arm for attachment to the hydraulic engine lift without including the hydraulic engine lift within the kit.

The example kit can include an air-over-hydraulic jack.

The example kit can include an electric-over-hydraulic jack.

The example kit can include an air delivery system including any one or more air delivery components described herein.

One or more suction cups of the kit can be arranged like suction cup shown in FIG. **7**.

One or more suction cups of the kit can be arranged like suction cup shown in FIG. **8**.

The example kit can include base **102**, hoist arm, and hoist arm support.

The example kit can include fasteners for attachment or retaining segments of base **102**, hoist arm, hoist arm support, and panel holder **106** together.

The example kit can include fasteners for attaching rotator **108** to hydraulic engine lift.

The example kit can include any component as shown in the figures or as described herein. The components of the example kit can be unassembled, at least partially, for shipment of the kit similar to components shown in FIG. **12**.

#### V. Example Uses

Example operations performable using the example panel hoists were discussed previously. Now, more particular example operations performable using an example panel hoist are discussed.

A panel hoist, in accordance with one or more example embodiments, can be used to hold a panel while the panel is painted or prepared in some other manner prior to attachment of the panel to a panel attachment item (for example, a wall or a semi-tractor trailer).

A panel hoist, in accordance with one or more example embodiments, can be used to hold a door panel as door hardware, such as hinges, handles, or locks, is attached to the door panel.

A panel hoist, in accordance with one or more example embodiments, can be used to lift and then hold a door panel in a desired position as the door panel is attached to a semi-tractor trailer.

A panel hoist, in accordance with one or more example embodiments, can be used to lift and then hold a side panel in a desired position as the side panel is attached to a semi-tractor trailer.

A panel hoist, in accordance with one or more example embodiments, can be attached to a panel prior to removal of

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the panel from a panel attachment item to which the panel is attached and pulled away from the item. Thereafter, the panel hoist can be used to lower the removed panel from a first position to a second position (lower than the first position).

A panel hoist, in accordance with one or more example embodiments, can be used to lift and then hold a board in a desired position as the board is attached to a wall or other structure.

A panel hoist, in accordance with one or more example embodiments, can be used to reposition a panel. Repositioning the panel can include rotating the panel to a vertical or substantially vertical position by turning rotator **108**. Repositioning the panel can include rotating the panel to a horizontal or substantially horizontal position by turning rotator **108**. Repositioning the panel can include raising and lowering the panel or rotating the panel to a position between a vertical position and a horizontal position of the panel.

A panel hoist, in accordance with one or more example embodiments, can be rolled or otherwise moved towards an opening on a van or trailer body for positioning of a panel for attaching the panel to the van or trailer body.

## VI. Additional Details and Alternative Arrangements

FIG. **13** shows details of a panel holder **1300** in accordance with one or more example embodiments. Panel holder **1300** can be used as part of a panel hoist, such as panel hoist **100**. For example, panel holder **1300** can be used as part of panel hoist **100** in place of panel holder **106**.

Panel holder **1300** includes a bracket body **1302**, a multi-position branch bracket **1304**, and a branch bracket **1306**. Bracket body **1302** can include or be made of a rectangular or circular steel pipe or tube. Similarly, branch bracket **1306** can include or be made of a rectangular or circular steel pipe or tube. Other examples of material(s) used to make bracket body **1302** and branch bracket **1306** and the shapes of those material(s) are also possible.

Branch bracket **1306** and multi-position branch bracket **1304** include extensions **1356** and **1358**, respectively. Extensions **1356** and **1358** can include or be made of a rectangular or circular steel pipe or tube. The dimensions of extensions **1356** and **1358** can be selected for positioning extensions **1356** and **1358** within or surrounding a portion of bracket body **1302**. A fastener **1318** can be positioned within extension **1356** and bracket body **1302** to attach bracket body **1302** and branch bracket **1306** together. Similarly, a fastener **1374** can be positioned within extension **1358** and bracket body **1302** to attach bracket body **1302** and multi-position branch bracket **1304** together. Fasteners **1318** and **1374** can comprise a rounded retainer locking pin having a 0.25 inch diameter and a length of 2.5 inches and a through-hole for installing a cotter pin or other fastener retainer. Alternatively, fasteners **1318** or **1374** can comprise a hex head bolt and nut, or some other type of fastener.

In an alternative arrangement, an end portion **1336** of branch body **1302** can be positioned within branch bracket **1306**, with or without use of extender **1356**. FIG. **13** illustrates, using broken lines, an example position for fastener **1318** in accordance with this alternative arrangement.

In another alternative arrangement, an end portion **1338** of branch body **1302** can be positioned between branch attachment portion **1368** and a second branch attachment portion (not shown) of multi-position branch bracket **1304**, with our without use of extender **1358**. FIG. **13** illustrates, using broken lines, an example position for fastener **1374** in accordance with this alternative arrangement.

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Branch extenders **1360** and **1362** can be positioned within or surrounding portions of branch bracket **1306**. A fastener **1316** can be positioned within branch extender **1362** and branch bracket **1306** to attach those components together. Similarly, a fastener **1376** can be positioned within branch extender **1360** and branch bracket **1306** to attach those components together. Fasteners **1316** and **1376** can comprise a rounded retainer locking pin having a 0.25 inch diameter and a length of 2.5 inches and a through-hole for installing a cotter pin or other fastener retainer. Other examples of fasteners **1316** and **1376** are also possible. Fasteners **1316** and **1376** can be positioned within attachment holes of branch extenders **1360** and **1362** that align with attachment holes of branch bracket **1306**.

A suction cup **1308** can be positioned at a distal end of branch extender **1362** relative to bracket body **1302**, and a suction cup **1310** can be positioned at a distal end of branch extender **1360** relative to bracket body **1302**. Branch extenders **1360** and **1362** or branch bracket **1306** can be configured with multiple attachment holes to allow one or more of branch extenders **1360** and **1362** to slide within or over branch bracket **1306** such that a suction cup attached to those branch extenders is moved closer to or further away from bracket body **1302**.

Multi-position branch bracket **1304** includes branch attachment portion **1368**, the second branch attachment portion (not shown), and multiple branch attachment portion separators. Each of those components can be made of metal, such as any of a plurality of types of steel. Each branch attachment portion separator can comprise a rectangular piece of steel plate, such as a two inch by two inch by three eighths inch steel plate welded to or near the straight edges of the two branch attachment portions. One or more of the branch attachment portion separators can be positioned between the two branch attachment portions.

Each of the branch attachment portions can be similarly shaped, such as the semi-circle shaped branch attachment portion **1368**. Each of the branch attachment portions can have multiple fastener holes **1340**. The branch attachment portions can be separated by the multiple branch attachment portion separators and by branches **1364** and **1366**. The branch attachment portions can be aligned such that fastener holes **1340** of branch attachment portion **1368** align with similarly-positioned fastener holes in the second branch attachment portion.

Panel holder **1300** includes branches **1364** and **1366**, branch extenders **1330** and **1370**, and suction cups **1312** and **1314**. Suction cup **1312** is attached at a distal end of branch extender **1330** relative to multi-position branch bracket **1304**. Similarly, suction cup **1314** is attached at a distal end of branch extender **1370** relative to multi-position branch bracket **1304**. In an alternative arrangement, suction cup **1312** can be attached directly to branch **1364** without using branch extender **1330**, and suction cup **1314** can be attached directly to branch **1366** without using branch extender **1370**.

Branch extenders **1330** and **1370** or branches **1364** and **1366** can be configured with multiple attachment holes to allow one or more of branch extenders **1330** or **1370** to slide within or over branch extenders **1330** and **1370** such that a suction cup attached to one of those branch extenders is moved closer to or further away from multi-position branch bracket **1304**. Fasteners **1378** and **1380** can be positioned within attachment holes of branch extenders **1330** and **1370** that align with attachment holes of branches **1364** and **1366**, respectively. Fasteners **1378** and **1380** can be configured like fastener **1318** or another fastener.

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Branch **1364** is attached to multi-position branch bracket **1304** using fasteners **1342** and **1384**, and branch **1366** is attached to multi-position branch bracket **1304** using fasteners **1372** and **1382**. As an example, fasteners **1342**, **1372**, **1382**, and **1384** can comprise hex head bolts and nuts or fastener pins, such as clevis pins. Branches **1364** and **1366** can swing up and down while rotating about fasteners **1384** and **1372**, respectively, and while fasteners **1342** and **1382** are not installed.

Branch **1364** can be repositioned and attached within multi-position branch bracket **1304** by removing fastener **1342**, loosening fastener **1384** if fastener **1384** comprises a bolt and nut, sliding branch **1364** from its current position to a new position, aligning branch **1364** so that a fastener hole within branch **1364** aligns with a fastener hole **1340** at the new position, installing fastener **1342** at the new position, and tightening fasteners **1342** and **1384** if fastener **1384** comprises a bolt and nut. Similarly, branch **1366** can be repositioned and attached within multi-position branch bracket **1304** by removing fastener **1382**, loosening fastener **1372** if fastener **1372** comprises a bolt and nut, sliding branch **1366** from its current position to a new position, aligning branch **1366** so that a fastener hole within branch **1366** aligns with a fastener hole **1340** at the new position, installing fastener **1382** at the new position, and tightening fasteners **1372** and **1382**.

Panel holder **1300** comprises secondary panel holders **1320** and **1324** and gripper clips **1322** and **1326** attached to secondary panel holders **1320** and **1324**, respectively. FIG. **13** shows secondary panel holder **1320** attached to multi-position branch bracket **1304** and secondary panel holder **1324** attached to bracket body **1306**. One or more of secondary panel holders **1320** and **1324** can be attached to another portion of panel holder **1300**. Secondary panel holders **1320** and **1324** can each be configured like secondary panel holder **116**. For example, secondary panel holders **1320** and **1324** can each include a first strap, a second strap, a first ratchet tensioner, and a second ratchet tensioner. Secondary panel holders **1320** and **1324** can be used to hold a panel in the manner in which secondary panel holders are used to hold panel **104** as shown in FIG. **1**.

Panel holder **1300** comprises attachment bracket segments **1332** and **1334** for attaching panel holder **1300** to a hoist arm, such as hoist arm of panel hoist **100**. Attachment bracket segments **1332** and **1334** can be configured like attachment bracket segments as shown in FIG. **12**.

Panel holder **1300** comprises attachment bracket **1328** for attaching panel holder **1300** to a rotator, such as rotator **108**. Attachment bracket **1328** can be configured like attachment bracket, as shown in FIG. **12**.

Panel holder **1300** can comprise multiple air supply lines and an air distributor valve **1354** to which the air supply lines can be attached. The air supply lines can include an air line **1344** that supplies air to air distributor valve **1354**, and air lines **1346**, **1348**, **1350**, and **1352** that connect to suction cups **1310**, **1308**, **1314**, and **1312**, respectively.

FIG. **13** shows suction cups **1308**, **1310**, **1312**, and **1314** as being pneumatic suction cups. In an alternative arrangement, one or more of suction cups **1308**, **1310**, **1312**, and **1314** can comprise a manual suction cup.

In alternative arrangements usable with one or more example embodiments, a multi-position branch bracket like multi-position branch bracket **1304** can be attached at both ends of bracket body **1302**. In accordance with those alternative arrangements, one of the multi-position branch brackets is used in place of branch bracket **1306**. In other alternative arrangements usable with one or more example embodi-

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ments, a branch bracket like branch bracket **1306** can be attached at both ends of bracket body **1302**. In accordance with those other alternative arrangements, one of the branch brackets is used in place of multi-position branch bracket **1304**.

FIG. **13** shows an alternative branch **1390** that can be used with panel holder **1300** instead of multi-position branch bracket **1304** or branch bracket **1306**. Branch **1390** has a branch attachment segment **1392**, a suction cup **1394**, and an attachment hole **1396**. Branch attachment segment **1392** can attach to bracket body **1302** using fastener **1318** or **1374** in the manner in which extensions **1356** and **1358** are attached to bracket body. Suction cup **1394** can comprise a pneumatic or manual suction cup.

Next, FIG. **14** shows an example panel rotator **1400** (or more simply, a rotator) and various panel hoist components in accordance with one or more example embodiments. The panel hoist components include hoist arm **1444**, stabilizer **1454**, hoist arm support **1456**, and jack ram **1462**. Hoist arm **1444** includes an attachment hole **1458** for attaching hoist arm **1444** to an attachment bracket, such as attachment bracket segments and shown in FIG. **11** and attachment bracket segments **1332** and **1334** shown in FIG. **13**. Hoist arm **1444** can be configured like hoist arm shown in FIG. **1**. Stabilizer **1454** can be configured like stabilizer shown in FIG. **1**. Hoist arm support **1456** can be arranged like hoist arm support shown in FIG. **1**. Jack ram **1462** can be configured like jack ram shown in FIG. **2**.

Rotator **1400** includes a handle **1402**, a handle bracket **1404**, a threaded shaft (or threaded rod) **1420**, rotator shaft segments **1418**, **1422**, **1424**, **1426**, and panel holder attachment brackets **1436** and **1438**. Handle **1402** and handle bracket **1404** can be attached together using a fastener **1408**, such as a hex head bolt and a lock washer. Rotator shaft segments **1422**, **1424**, and **1426** can be formed from a single steel bar or tube. Rotator shaft segment **1418** can be formed from a single steel bar or tube.

Rotator shaft segment **1424** provides for rotator shaft segments **1422** and **1426** being offset from one another. The offset provided by rotator shaft segment **1424** provides for rotator shaft segment **1426** and panel holder attachment brackets **1436** and **1438** to be in line with hoist arm **1444**, such that hoist arm **1444** and panel holder attachment brackets **1436** and **1438** can be attached to panel hoist **106** or **1300**. Panel holder attachment brackets **1436** and **1438** include attachment holes **1440** and **1442**, respectively, for receiving a fastener to attach rotator **1400** to attachment bracket. Panel holder brackets **1436** and **1438** can form a U-shaped yoke that is configured to fit over an attachment bracket (such as attachment bracket **1328**) on a panel holder and that is configured to be retained to the attachment bracket by a fastener pin or other fastener positioned within attachment holes **1440** and **1442**.

Rotator **1400** includes fasteners **1428** and **1430** to attach rotator shaft segments **1418** and **1422** to one another. FIG. **14** shows fasteners **1428** and **1430** as clevis or retainer pins secured to rotator shaft segments **1428** and **1430** by cotter pins **1434** and **1432** respectively. Alternatively, fasteners **1428** and **1430** can comprise hex head bolts and nuts or some other type of fastener. Fasteners **1428** and **1430** can be removed to allow for disassembly of rotator **1400** so as to allow for easier shipment of a rotator **1400** or a panel hoist including rotator **1400**.

Rotator **1400** includes nuts **1406**, **1410**, and **1414** having set screws **1448**, **1450**, and **1446**, respectively. Those set screws provide for positioning nuts **1406**, **1410**, and **1414** to threaded shaft **1420** so that nuts **1406**, **1410**, and **1412** turn with threaded shaft **1420**. Rotator **1400** also includes nut **1416**

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and swivel ball joint **1412**. Threaded shaft **1420** slides through and spins on swivel ball joint **1412**. Nuts **1410** and **1414** can be used as stops to position threaded rod **1420** within swivel ball joint **1412**. Nut **1416** can be welded or otherwise attached to rotator shaft segment **1418**. Threaded shaft **1420** can turn and move through nut **1416** into or out of rotator shaft segment **1418** so as to change the length of rotator **1400**. The changing length of rotator **1400** causes a panel attached to a panel holder attached to rotator **1400** to rotate.

## VII. Conclusion

Example embodiments have been described above. Those skilled in the art will understand that changes and modifications can be made to the described embodiments without departing from the true scope and spirit of the present invention, which is defined by the claims.

We claim:

1. A panel hoist comprising:
  - a base;
  - a hoist arm connected to the base;
  - a jack configured to raise and lower the hoist arm;
  - a panel holder;
  - a rotator configured to rotate the panel holder,
    - wherein the length of the rotator is adjustable,
    - wherein the rotator comprises a shaft including a first shaft segment and a second shaft segment,
    - wherein the first shaft segment includes a first end and a second end,
    - wherein the first end of the first shaft segment includes a first threaded portion,
    - wherein the second shaft segment includes a first end and a second end,
    - wherein the first end of the second shaft segment includes a second threaded portion configured to engage the first threaded portion of the first shaft segment,
    - wherein the second end of the second shaft segment is configured for connection to the second rotatable joint;
  - a first rotatable joint that connects the hoist arm to the panel holder; and
  - a second rotatable joint that connects the rotator to the panel holder.
2. The panel hoist of claim 1, wherein the jack comprises a hydraulic jack or an air over hydraulic jack.
3. The panel hoist of claim 1, further comprising:
  - a swivel ball joint,
  - wherein the first shaft segment is configured to slide through and spin on the swivel ball joint, and
  - wherein a length of the rotator decreases by rotating a portion of the first shaft segment further into the second shaft segment and increases by rotating the portion of the first shaft segment out of the second shaft segment.
4. The panel hoist of claim 1,
  - wherein the first threaded portion is within an interior portion of the first end of the first shaft segment, and
  - wherein the second threaded portion is on an exterior portion of the first end of the second shaft segment.
5. The panel hoist of claim 1,
  - wherein the first threaded portion is on an exterior portion of the first end of the first shaft segment, and
  - wherein the second threaded portion is within an interior portion of the first end of the second shaft segment.

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6. The panel hoist of claim 1,
  - wherein the second shaft segment comprises a first segment portion including the first end, a second segment portion including the second end, and an offset portion between the first segment portion and the second segment portion,
  - wherein a longitudinal axis of the offset portion is not parallel to a longitudinal axis of the first segment portion, and
  - wherein the longitudinal axis of the offset portion is not parallel to a longitudinal axis of the second segment portion.
7. The panel hoist of claim 1, further comprising:
  - a plurality of suction cups connected to the panel holder; and
  - a plurality of air ejectors,
  - wherein each air ejector is configured to provide a vacuum in proximity to a respective suction cup of the plurality of suction cups.
8. The panel hoist of claim 1,
  - wherein the panel holder comprises a body and a plurality of arms extending from the body, and
  - wherein a respective suction cup and a respective air ejector are connected at a distal end, relative to the body, of each arm.
9. The panel hoist of claim 8, wherein each arm of the plurality of arms comprises a telescoping arm.
10. The panel hoist of claim 1,
  - wherein the panel holder comprises a body and a plurality of arms extending from the body, and
  - wherein a respective manual suction cup is connected at a distal end, relative to the body, of each arm.
11. The panel hoist of claim 1, further comprising:
  - a secondary panel holder connected to the panel holder.
12. The panel hoist of claim 11,
  - wherein the secondary panel holder comprises a first strap, a second strap, a first ratchet tensioner, and a second ratchet tensioner,
  - wherein the first ratchet tensioner and the second ratchet tensioner are attached to the panel holder,
  - wherein a first portion of the first strap is attachable to the first ratchet tensioner and a second portion of the first strap includes a first hook configured for contacting a panel,
  - wherein a first portion of the second strap is attachable to the second ratchet tensioner and a second portion of the second strap includes a second hook configured for contacting the panel,
  - wherein the first ratchet tensioner is operable to increase tension on the first strap, and
  - wherein the second ratchet tensioner is operable to increase tension on the second strap.
13. The panel hoist of claim 1, further comprising:
  - an air delivery system including a connector adapted for connection to an air supply line, and including at least one air delivery line adapted for supplying compressed air to an air ejector,
  - wherein the air ejector is adapted for providing a vacuum in proximity to a suction cup connected to the panel holder.
14. The panel hoist of claim 1, further comprising:
  - a hydraulic lift comprising the base and the hoist arm of the panel holder.
15. The panel hoist of claim 1,
  - wherein the panel holder comprises a branch body and a multi-position branch bracket removably attachable to the branch body,



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wherein the multi-position branch bracket includes attachment holes for attaching multiple branches to the multi-position branch bracket, and

wherein each branch of the multiple branches includes a suction cup proximate to a distal end of the branch relative to the multi-position branch bracket. 5

**16.** The panel hoist of claim **15**,

wherein a first branch of the multiple branches is removably attached to the multi-position branch bracket at a first position by a first fastener within a first attachment hole and a second fastener within a second attachment hole, 10

wherein the first branch can be removably attached to the multi-position branch bracket at a second position by the first fastener within the first attachment hole and the second fastener within a third attachment hole, and 15

wherein the first branch is configured to pivot about the first fastener during movement of the first branch from the first position to the second position.

**17.** The panel hoist of claim **16**, further comprising: 20

a branch bracket removably attachable at a first end of the branch body,

wherein at least one suction cup is attached to the branch bracket, and

wherein the multi-position branch bracket is removably attachable to a second end of the branch body opposite the first end of the branch body. 25

**18.** The panel hoist of claim **15**,

wherein the multi-position branch bracket comprises a first branch attachment portion, a second branch attachment portion, and one or more branch attachment portion separators positioned between the first branch attachment portion and the second branch attachment portion, and 30

wherein portions of each branch of the multiple branches can be positioned between the first branch attachment portion and the second branch attachment portion. 35

**19.** The panel hoist of claim **18**, wherein first branch attachment portion comprises a first semi-circled shaped steel plate and the second branch attachment portion comprise a second semi-circled shaped steel plate. 40

**20.** A kit comprising:

a panel holder;

a rotator configured to rotate the panel holder, wherein the length of the rotator is adjustable; 45

a first rotatable joint adapted to be connected to the panel holder and to a hoist arm of a hydraulic lift,

a second rotatable joint adapted to connect the rotator to the panel holder; and

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a plurality of suction cups adapted for connection to the panel holder;

a secondary panel holder connected to the panel holder,

wherein the secondary panel holder comprises a first strap, a second strap, a first ratchet tensioner, and a second ratchet tensioner,

wherein the first ratchet tensioner and the second ratchet tensioner are attached to the panel holder,

wherein a first portion of the first strap is attachable to the first ratchet tensioner and a second portion of the first strap includes a first hook configured for contacting a panel,

wherein a first portion of the second strap is attachable to the second ratchet tensioner and a second portion of the second strap includes a second hook configured for contacting the panel,

wherein the first ratchet tensioner is operable to increase tension on the first strap, and

wherein the second ratchet tensioner is operable to increase tension on the second strap.

**21.** A kit comprising:

a panel holder;

a rotator configured to rotate the panel holder, wherein the length of the rotator is adjustable,

wherein the rotator comprises a shaft including a first shaft segment and a second shaft segment,

wherein the first shaft segment includes a first end and a second end,

wherein the first end of the first shaft segment includes a first threaded portion,

wherein the second shaft segment includes a first end and a second end,

wherein the first end of the second shaft segment includes a second threaded portion configured to engage the first threaded portion of the first shaft segment,

wherein the second end of the second shaft segment is configured for connection to the second rotatable joint;

a first rotatable joint adapted to be connected to the panel holder and to a hoist arm of a hydraulic lift,

a second rotatable joint adapted to connect the rotator to the panel holder; and

a plurality of suction cups adapted for connection to the panel holder.

**22.** The kit of claim **21**, further comprising:

an air-over-hydraulic jack.

\* \* \* \* \*